Floods of December 1964 and January 1965 in the Far Western States

Part 1. Description

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1866-A

Prepared in cooperation with the States of California, Idaho, Nevada, Oregon, and Washington, and with other agencies

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By A. O. WAANANEN, D. D. HARRIS, and R. C. WILLIAMS

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PREFACE

This report gives a comprehensive summary and detailed data for the recordbreaking floods of December 1964 and January 1965 in the Far Western States. The detailed report supersedes a preliminary report, "Floods of December 1964 in the Far Western States," which presented selected data available shortly after the floods and which was released to the open file in March 1965.

This report presents data on flood stages and discharges, with descriptions of the storms that produced the floods and of the areal extent and effects of the floods. Data on sediment discharge are given for many streams. Some very high sediment concentrations are reported, and the sediment loads transported during the principal flood periods were very substantial.

This report is presented in two parts. The general description of the storms and floods, discussion of the floods and flood damage in the several basins, and summaries of flood damage, maximum stages and discharges, and maximum sediment concentrations and loads, are presented as Part 1, Description, in U.S. Geological Survey Water-Supply Paper 1866–A.

Basic records of stage, discharge, sediment concentration and load are presented as Part 2, Streamflow and sediment data, in Water-Supply Paper 1866–B. These data were collected by the U.S. Geological Survey as part of a continuous program in cooperation with the States of California, Idaho, Nevada, Oregon, and Washington; county and municipal agencies within these States; and agencies of the Federal Government.

This report was prepared by the U.S. Geological Survey, Water Resources Division, under the general direction of L. B. Leopold, chief hydrologist, and his successor, E. L. Hendricks, Jr.

CONTENTS

ILLUSTRATIONS

TABLES

FLOODS OF DECEMBER 1964 AND JANUARY 1965 IN THE FAR WESTERN STATES

PART 1. DESCRIPTION

By A. O. WAANANEN, D. D. HARRIS and R. C. WILLIAMS

ABSTRACT

The floods of December 1964 and January 1965 in the Far Western States were extreme; in many areas, the greatest in the history of recorded streamflow and substantially greater than those of December 1955. An unusually large area—Oregon, most of Idaho, northern California, southern Washington, and small areas in western and northern Nevada—was involved. It exceeded the area flooded in 1955. Outstanding features included recordbreaking peak discharges, high sediment concentrations, large sediment loads, and extensive flood damage. The loss of 47 lives and direct property damage of more than $430 million was attributable to the floods. Yet, storage in reservoirs and operation of flood-control facilities were effective in preventing far greater damages in many areas, particularly in the Central Valley in California and the Willamette River basin in Oregon.

The floods were caused by three principal storms during the period December 19 to January 31. The December 19–23 storm was the greatest in overall intensity and areal extent. Crests occurred on many major streams December 23, 1964, 9 years to the day after the great flood of December 23, 1955. The January 2–7 storm produced extreme floods in some basins in California. The January 21–31 storm produced maximum stages in some streams in northeastern Oregon and southeastern Washington and a repetition of high flows in part of the Willamette River basin and in some basins in coastal Oregon. All the storms, and particularly the warm torrential rain December 21–23, reflected the combined effect of moist unstable airmasses, strong west-southwest winds, and mountain ranges oriented nearly at right angles to the flow of air. High air temperatures and strong winds associated with the storms caused melting of snow, and the meltwater augmented the rain that fell on frozen ground. The coastal areas of northern California and southern Oregon had measurable rain on as many as 50 days in December and January. A maximum precipitation of nearly 69 inches in the 2-month period was recorded in southern Oregon, and recorded runoff at several streamflow-measurement stations indicates that greater precipitation probably occurred at higher altitudes in these areas.

Flood runoff in streams, not affected by regulation, exceeded any previously recorded throughout much of the area. Some streams that had particularly notable floods are: Deep and Plush Creeks in the Great Basin in Oregon, where the maximum flows were nearly twice those of the record floods of 1963; Thomes Creek, a west-side Sacramento River tributary in the Central Valley, where the maximum flow was 160 percent of the record peak of 1955; Eel, Klamath, and Smith Rivers in north-coastal California, where the catastrophic peak flows were about 1-1/3 times the floods of 1955 and the legendary winter floods of 1861–62 and inundated, damaged, or destroyed nearly all communities along the main rivers; Grande Ronde River in the lower Snake River basin, where the peak discharge at La Grande was 1.6 times the previous maximum flow during 57 years of record; John Day River in the lower Columbia River basin, where the peak discharge at the McDonald Ferry gaging station exceeded the historic peak of 1894; many Willamette River tributaries, where maximum flows exceeded previous record flows; and the Rogue River in coastal Oregon, where the maximum flow of about 500,000 cfs below the Illinois River near Agness was 86,000 cfs greater than the previous maximum in a 74-year record. The partly regulated flow of the Willamette River far exceeded that in 1955.

The suspended-sediment concentration and load of most streams greatly exceeded any that had been measured previously in the flood area. In Idaho, Washington, and Oregon, the ground thaw that preceded the period of high runoff resulted in conditions conducive to severe erosion of the uplands and subsequent deposition on flooded stream terraces. The greatest concentrations of suspended sediment occurred in streams that drained areas bordering the lower Snake and lower Columbia Rivers. Maximum concentrations in four of these streams ranged from 220,000 to 360,000 ppm (parts per million). Suspended-sediment concentrations in streams in northern California greatly exceeded those previously observed subsequent to the floods of 1955; a maximum of 76,000 ppm occurred in Thomes Creek in the Sacramento River basin. Sediment data were not obtained in 1955. Landslides, washouts, and streambed and bank erosion contributed tremendous quantities of sediment. The suspended-sediment load of 57 million tons transported by the Eel River at Scotia December 23 was about 10 times the maximum load of record (1957-64).

This report presents a general description of the December 1964 and January 1965 floods, details and estimates of the damage incurred, a summary of peak stages and discharges and comparative data for previous floods at 1,240 sites, and a summary of suspended-sediment concentrations and daily sediment loads at 109 sites.

Also included are discussions of the storm precipitation during the 2-month period, sedimentation, flood regulation by storage reservoirs and recurrence intervals of peak discharges, as well as tables of flood-crest stages along the San Joaquin, Sacramento, Russian, and Eel Rivers in California, and the Willamette River in Oregon.

Station data on stage and discharge, and sediment concentration and load, where pertinent, obtained at 1,254 sites in the flood area are assembled in Water-Supply Paper 1866–B.

INTRODUCTION

In late December 1964 and January 1965 the Far Western States were subjected to extreme floods; in many areas, the greatest in the history of recorded streamflow and substantially greater than those of December 1955. Intense flood-producing rains fell in Oregon, most of Idaho, the northern half of California, the southern part of Washington, and small areas in western and northern Nevada. The

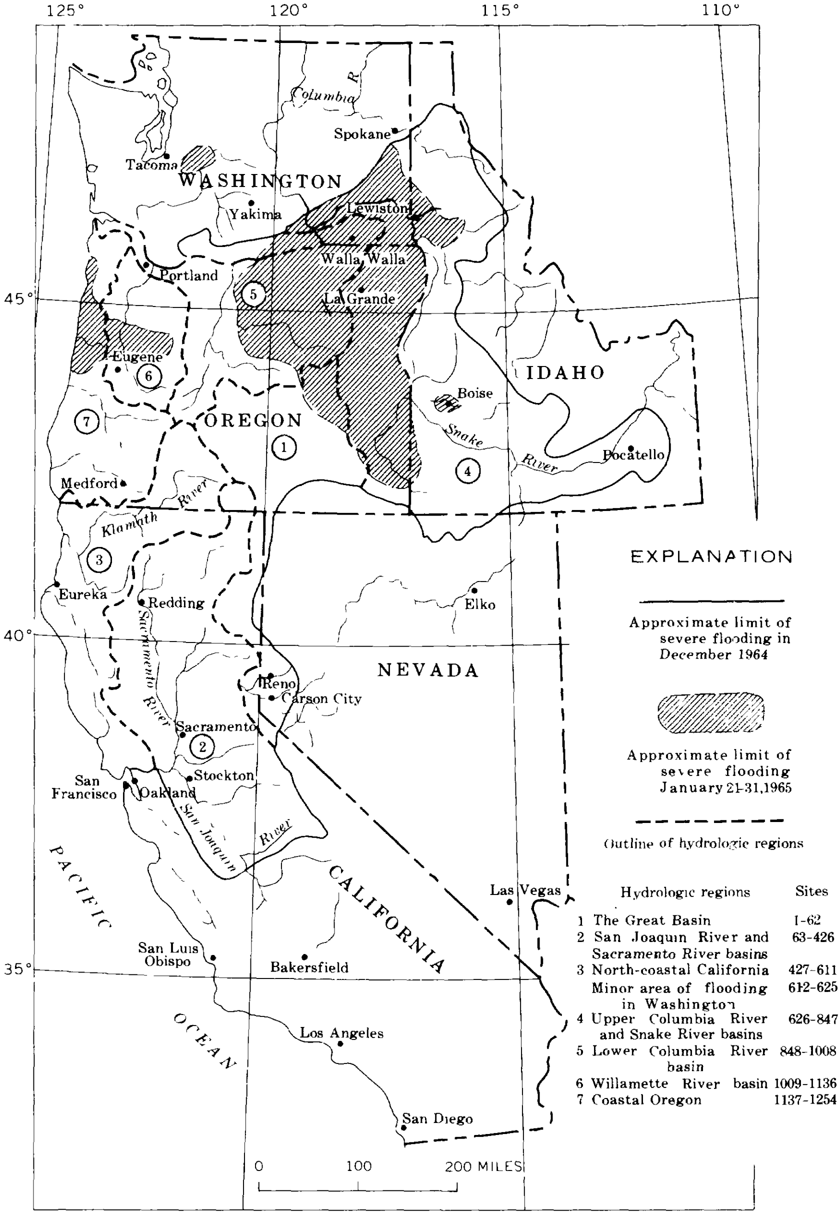

FIGURE 1.—Areas of severe flooding during December 1964 and January 1965, hydrologic regions used in this report, and range in numbers of the flood-data sites in each region.

areas of severe flooding are shown in figure 1. The total area encompassed was about 200,000 square miles, substantially greater than that affected by the memorable floods of December 1955.

The floods caused the loss of at least 47 lives and direct property damage of more than $430 million. The flood damage was most severe in northern and coastal California and in the Willamette River basin in Oregon. The indirect damage caused by the floods was incalculable and consisted of losses in salaries and business volume, reduced crop production, reduced industrial production, traffic delays and rerouting, reduced tourist trade, and losses in other intangible items affecting the general economy and welfare. The extensive reservoir and flood-control facilities particularly in the San Joaquin River and Sacramento River basins in California and in the Willamette River basin in Oregon, substantially reduced the magnitudes of the downstream flood peaks and prevented potentially far greater flood damage.

The storm period December 19–January 31 included three principal storms. The December 19–23 storm was the greatest in overall intensity and areal extent and generally caused the highest flood peaks. The January 2–7 storm produced extreme floods in some basins in California. The January 21–31 storm produced maximum stages in some streams in northeastern Oregon and southeastern Washington and caused a repetition of extreme stages in part of the Willamette River basin and in some basins in coastal Oregon. Intermittent storms from December 24 to January 1 throughout most of the area caused minor peaks and generally maintained streams at or near flood stage.

This report provides detailed hydrologic data supplementing the data on stage and discharge and sediment concentration and load published in the annual streamflow and water-quality reports of the U.S. Geological Survey. These data have various uses, as in flood-control planning, water-resources development, design of structures for water storage or control, design of structures on flood plains, and other aspects of water use and management that involve flood hydrology.

Part 1 of this report presents a general description of the floods and includes information on precipitation during the flood period, characteristics of the floods in the major basins, flood damage, effects of storage regulation, and flood-crest stages. Tables summarizing flood stages and discharges and sediment concentrations and loads are included. Station descriptions and detailed data on stages and discharges and sediment concentration and load are presented as part 2.

To facilitate presentation of the data, the area of severe flooding has been divided into seven subareas, or hydrologic regions, as outlined in figure 1. These subareas are identified as the Great Basin, San Joaquin River and Sacramento River basins, north-coastal California, upper Columbia River and Snake River basins, lower Columbia River basin, Willamette River basin, and coastal Oregon. Data are also included for a small area in Washington affected by the late January storm. Nearly all topics in this report are discussed individually for each of the subareas, thus enabling the reader interested in a particular subarea to readily obtain the pertinent information.

All sites at which data on stage and discharge are available, including sites where data on sediment concentration and load were obtained, are numbered consecutively in downstream order and in the same sequence of parts—from part 10 through part 14—used in the annual Geological Survey reports "Water Resources Data." Included in the numbering are gaging stations, reservoir stations, partial-record stations, and miscellaneous sites. References in the text presenting quantitative data for flood-determination points use these numbers (in parentheses) to identify the sites. The range of numbers for the sites in each subarea at which hydrologic data were collected is shown in figure 1. The location of each site is shown on the map included with the description of floods for each region. In the summary tables and in the station-data presentations, the permanent network-station number is also given for additional identification.

The hydrologic terms and abbreviations used in this report are defined as follows:

1. Acre-foot (acre-ft) is the quantity of water required to cover 1 acre to a depth of 1 foot and is equal to 43,560 cubic feet (325,851 gals).
2. Bedload is the sediment that moves by sliding, rolling, or skipping on or very near the streambed; the sediment is moved by tractive or gravitational forces, or both, at velocities less than that of adjacent flow.
3. Contents is the volume of water in a reservoir or lake. Unless otherwise indicated, contents is computed on the basis of a level pool and does not include bank storage.
4. Cubic feet per second (cfs) is the rate of discharge. One cubic foot per second is equal to the discharge of a stream of rectangular cross section, 1 foot wide and 1 foot deep, flowing at an average velocity of 1 foot per second.
5. Drainage area of a stream at a specified location is that area,

measured in a horizontal plane, which is enclosed by a drainage divide. Figures of drainage area given herein include all closed basins, or noncontributing areas, unless otherwise noted.

6. Gage height is the water-surface elevation referred to some arbitrary gage datum. Gage height is often used interchangeably with the more general term "stage," although gage height is more appropriate when used with a reading on a gage.
7. Gaging station is a particular site on a stream, canal, lake, or reservoir where systematic observations of gage height or discharge are obtained.
8. Miscellaneous site is a site other than a gaging station, sediment station, or partial-record station, where data pertaining to a specific hydrologic event are obtained.
9. Partial-record station is a particular site where limited hydrologic data are collected systematically for a period of years.
10. Particle size is the diameter, in millimeters (mm), of suspended sediment or bed sediment. A classification recommended by the Subcommittee on Sediment Terminology of the American Geophysical Union (Lane and others, 1947, p. 937) defines a particle having a diameter of less than 0.004 mm as clay; between 0.004 and 0.062 mm as silt; and between 0.062 and 2.0 mm as sand.
11. Runoff is that part of the precipitation that appears in surface streams. It is the same as streamflow unaffected by artificial diversions, storage, or other works of man in or on the stream channels. Runoff, given in inches (in.), is the depth to which the drainage area would be covered if the runoff for a given time period were uniformly distributed over the surface.
12. Sediment is fragmental material that originates from weathering of rocks and is transported by, suspended in, or deposited by water or air or is accumulated in beds by other natural agencies.
13. Sediment concentration is the weight of dry solids divided by the weight of water-sediment mixture and is expressed in parts per million (ppm).
14. Sediment discharge is the rate at which dry weight of sediment passes a section of a stream or is the quantity of sediment, as measured by dry weight or by volume, that is discharged in a given time.
15. Sediment load is the sediment moved by a stream, whether in suspension or at the bottom. It is synonymous with "sediment discharge" in this report and is used to avoid possible confusion between stream discharge and sediment discharge.

16. Sediment station is a river section where samples are taken each day, or periodically.
17. Stage-discharge relation is the relation between gage height and the amount of water flowing in a channel, expressed as volume per unit of time.
18. Streamflow is the discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal the word "streamflow" uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than the term "runoff," as streamflow may be applied to discharge whether or not it is affected by diversion or regulation.
19. Suspended load is the sediment that moves in suspension. It is transported at essentially the velocity of water.
20. Suspended sediment is the sediment that at any given time is maintained in suspension by the upward components of turbulent currents or that exists in suspension as a colloid.
21. Tons per day is the unit used in this report to express the quantity of sediment that passes a stream section during a 24-hour period.
22. Total sediment load is a term used in this report for the sediment load computed at a few sites. It includes sediments both moved in suspension and at the bottom.

A preliminary report (Rantz and Moore, 1965) contained selected streamflow and sediment data available, as of February 15, 1965, for the floods in December 1964.

Special reports have been prepared for previous notable floods in the area that was flooded during December 1964 and January 1965. The floods of December 1955–January 1956 in the Far Western States, reported by Hofmann and Rantz (1963 a, b) were the greatest of record for much of the area. The water-supply papers in which these reports have been presented, and the dates of occurrence and the areas affected by these floods are given in the following tabulation.

Water-Supply Paper	*Date*	*Region*
96	June 1903	Heppner, Oreg.
843	December 1937	Northern California.
968–A	Flood runoff, 1813–1938	Willamette Valley, Oreg.
1080	May–June 1948	Columbia River basin.
1137–E	October–November 1950	Southwestern Oregon and northwestern California.
1137–F	November–December 1950	Central Valley region, California.

Water-Supply Paper	Date	Region
1137–H	November–December 1950	Western Nevada.
1260–D	January 1952	South San Francisco Bay region, California.
1260–D	Snowmelt flood, 1952	Kern River, Tulare Lake, and San Joaquin River basins, California.
1320–D	January 1953	Western Oregon and northwestern California.
1530	January, February 1956	California.
1530	May 1956	Idaho.
1530	July 1956	Nevada.
1530	January, July, December 1956	Oregon.
1530	February, August 1956	Washington.
1650–A	December 1955–January 1956	Far Western States (Part 1, Description).
1650–B	December 1955–January 1956	Far Western States (Part 2, Streamflow Data).
1652–C	February 1957	Washington, Oregon, and Idaho.
1652–C	May and June 1957	Idaho.
1660–B	February, April 1958	California.
1660–B	February, May–June 1958	Idaho.
1790–B	February 1960	California.
1790–B	March, July–August 1960	Idaho.
1790–B	November 1960	Northwestern Oregon and southern Washington.
1810	February, August and September 1961	Idaho.
1810	May to June 1961	Columbia River basin.
1820	February 1962	Southern Idaho and northern Nevada and Utah.
1820	October 1962	Northern California.
1820	November 1962	Southwestern Washington.
1830–A	January-February 1963	California and Nevada.

ACKNOWLEDGMENTS

The data in this report were collected as part of cooperative programs between the U.S. Geological Survey and the States of California, Idaho, Nevada, Oregon, and Washington; Federal agencies, including the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, Bonneville Power Administration, and U.S. Forest Service; and many county and municipal agencies. The data were compiled in the U.S. Geological Survey district offices under supervision of Walter Hofmann, district chief, California; W. I. Travis, district engineer, Idaho; G. F. Worts, Jr., district chief, Nevada; R. B. Sanderson and G. L. Bodhaine, district engineers, Oregon;

and L. B. Laird, district chief, Washington. The collection of field data necessary for the computation of peak discharge by indirect methods was materially aided by assignment of personnel for survey parties by the Texas and Wyoming districts and the Washington, D.C., office of the Geological Survey and by the California Department of Water Resources and other agencies. Data furnished by other agencies are specifically acknowledged in the text.

The cooperation of the U.S. Weather Bureau and the U.S. Army Corps of Engineers in providing precipitation data, estimates of flood damage, and information on reservoir operation is gratefully acknowledged. Acknowledgment is made also to the many other individuals, corporations, and governmental agencies who furnished assistance and data for this report.

THE STORMS

The flood-producing conditions from November 1964 through January 1965 in northern and central California, Idaho, western Nevada, Oregon, and southern Washington included rains of unprecedented intensity and volume for such a vast area. The widespread intense rains of late December were followed by a storm of more limited extent in early January in California and another in late January, mainly in eastern Oregon and southeastern Washington. The principal storm period, December 19–January 31, was preceded by minor storms that primarily affected coastal areas, but also extended, with less effect, over much of the flood area. These antecedent storms caused moderate runoff in the coastal areas early in December. An Arctic airmass spread over much of the northern part of the flood area December 14–18, partly froze some of the ground, and generally produced conditions favorable for high runoff.

Fairly heavy precipitation began late December 18, but meteorological conditions gave no indication that storms of unusual intensity would follow. A high-pressure airmass over the Pacific Ocean occupied most of the ocean area between Hawaii and Alaska, effectively blocking the migration of moist tropical air to the west coast. Because the storm track was on the north side of the Pacific high, from the Gulf of Alaska to Oregon and northern California, the initial storm precipitation December 18–20 was accompanied by low temperatures and consisted largely of snow in the northern latitudes and at higher altitudes of the flood region.

Progressive erosion of the Pacific high in the subtropics northeast of Hawaii December 20 allowed subsequent storms to move across the Pacific Ocean at successively lower latitudes before they turned to the west coast. A storm track 500 miles wide extending from the western Pacific near Hawaii to Oregon and northern California was thus established. The concurrent outbreak of extremely cold air from the Arctic region mixing with the warm moist air about 1,000 miles west of the coast intensified the storm systems as they moved rapidly toward the mainland. The combination of moist unstable airmasses, strong west-southwest winds, and the orographic effect of mountain ranges oriented nearly at right angles to the flow of air resulted in torrential rain December 21–23. Temperatures rose sharply during this period; the freezing level rose to altitudes as high as 10,000 feet above mean sea level; and almost all precipitation was in the form of rain. Precipitation rates in excess of 8 inches in 24 hours were reported at a few precipitation stations in Oregon and were fairly commonplace in the mountains of California. Such widely separated stations in California as Whiskeytown Reservoir in the Klamath Mountains, Richardson Grove in the Coast Ranges, and Lake Spaulding in the Sierra Nevada reported more than 11 inches in 24 hours. A 24-hour total of 15 inches was reported at Ettersburg in the Mattole River basin in north-coastal California. A surge of rising pressure moved into the ocean area northeast of Hawaii December 24–31 and cut off the flow of warm moist air to the mainland. The weather pattern changed drastically: for several days heavy snow extended down to low altitudes, and intermittent rain and hail fell near sea level.

The air-circulation pattern early in January included a trough of low pressure along the Pacific coast, which caused heavy precipitation in the coastal areas January 2–7. Storminess associated with cyclonic airflow in the eastern Pacific area again caused heavy precipitation in the Pacific Northwest during the January 21–31 storm, the heaviest being in the western parts of Oregon and Washington. Though precipitation was not as great east of the Cascade Range, it was unusually heavy for that area. These rains, in combination with above-normal temperatures and resulting snowmelt runoff, caused severe flooding.

Measurable precipitation occurred on as many as 50 days in December and January at many stations in coastal areas of California and Oregon. More than 60 inches of precipitation was recorded for the 2 months at several stations in the Sierra Nevada and the coastal areas; a maximum of nearly 69 inches was reported at Valsetz, 30 miles west of Salem, Oreg. The recorded runoff at several gaging stations in north-coastal California and coastal Oregon indicates that greater precipitation probably occurred at higher altitudes, but precipitation data for the higher altitudes are scanty. The meteorology of the December and January storms is described generally by Posey (1965) and Andrews (1965).

Figures 2, 3, and 4 are isohyetal maps showing generalized precipitation distribution for the storms of December 19–23, January 2–7, and January 21–31 throughout the flood area. These maps are based mainly on Weather Bureau precipitation records, sup-

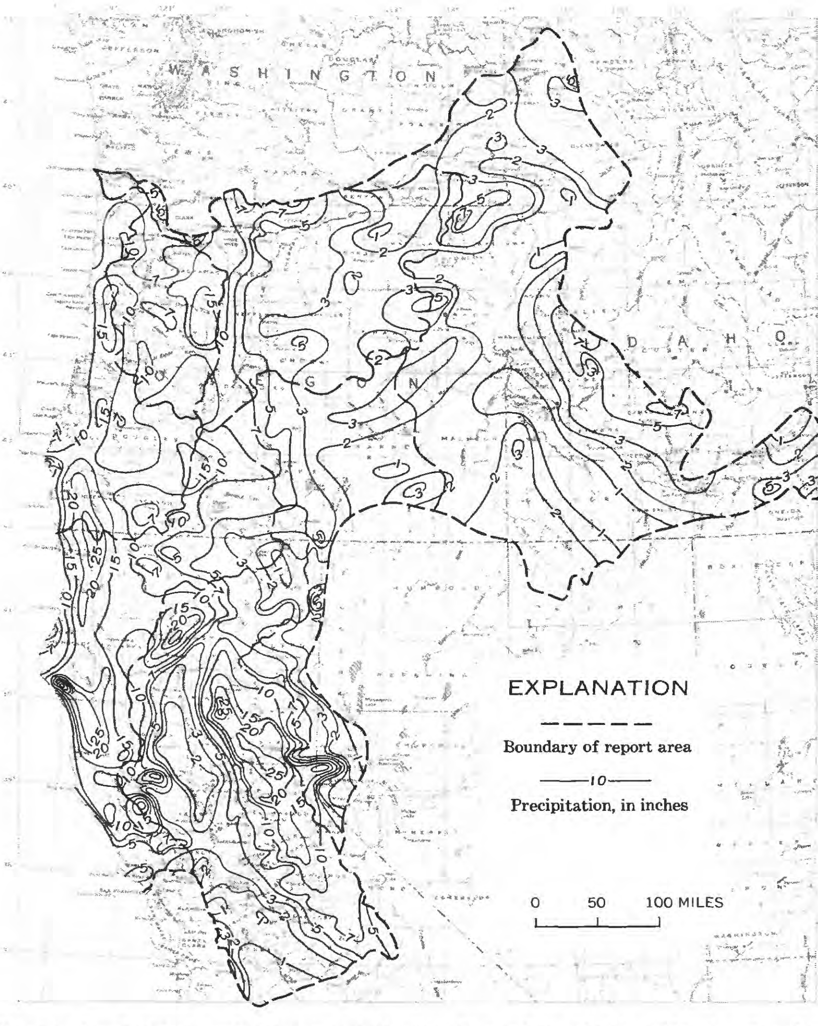

FIGURE 2.—Isohyets of total precipitation December 19–23, 1964, in the flood area.

plemented wherever possible by additional data. Precipitation totaling nearly 50 inches during the December 19–23 storm was reported at Ettersburg in the Mattole River basin (hydrologic region 3 in fig. 1); more than 25 inches occurred in the Sierra Nevada and upper Cache Creek, Eel River and Russian River basins, the Shasta Lake area in California, and in the Smith River and Rogue River basins near the California-Oregon border. Precipitation exceeded

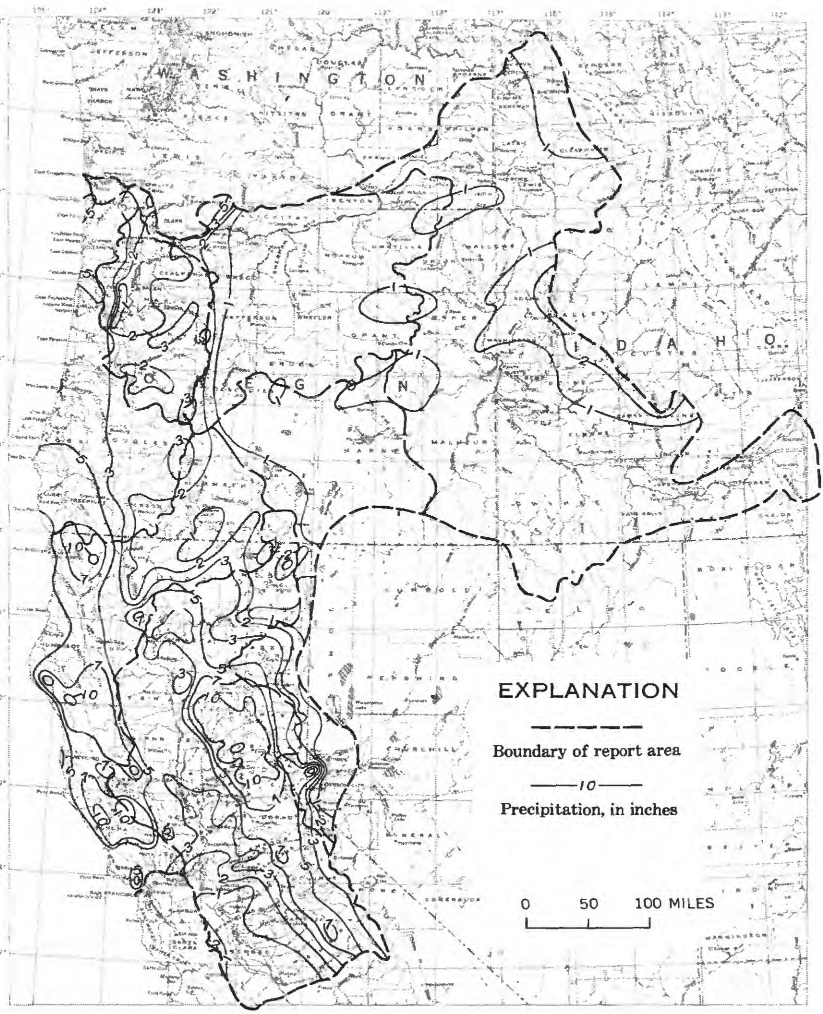

FIGURE 3.—Isohyets of total precipitation January 2–7, 1965, in the flood area.

15 inches during January 2–7 in the North Yuba River basin in the Sierra Nevada in California and during January 21–31 in the Santiam River basin and coastal areas in Oregon. Precipitation at selected stations during each of the three storms, during the antecedent period December 1–18, and in the intervals between the principal storms is listed in table 1 and discussed in the description of the storms for each hydrologic region.

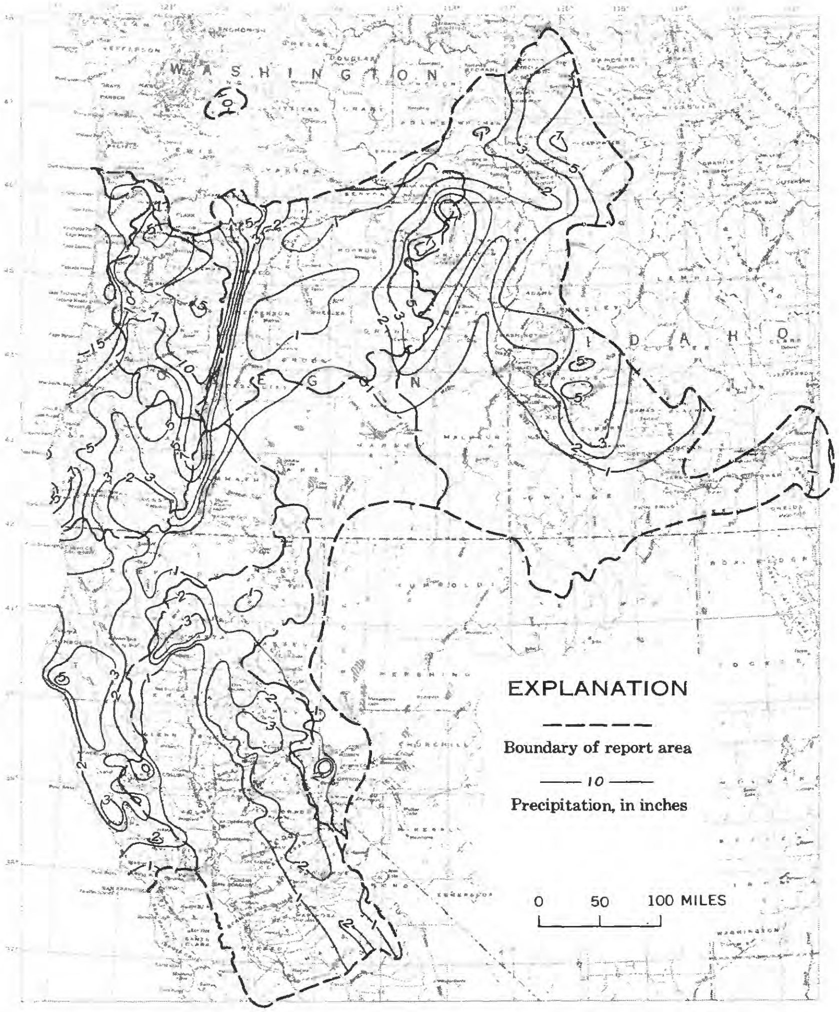

FIGURE 4.—Isohyets of total precipitation January 21–31, 1965, in the flood area.

TABLE 1.—*Precipitation, in inches, at selected stations during December 1964 and January 1965*

Precipitation station and subbasin	Antecedent precipitation	Storm precipitation					Total monthly precipitation	
	Dec. 1–18	Dec. 19–23	Dec. 24–Jan. 1	Jan. 2–7	Jan. 8–20	Jan. 21–31	December	January
The Great Basin:								
Woodfords, Calif. (Carson River)	1.21	7.23	4.51	2.27	0.56	1.40	12.95	4.23
Tahoe City, Calif. (Truckee River)	2.76	17.23	7.79	5.55	.45	1.51	27.55	7.74
Susanville, Calif. (Susan River)	.81	5.16	2.56	4.41	.38	1.10	8.53	5.89
Adel, Oreg. (Deep Creek)	.84	3.35	1.62	.56	.39	.15	5.81	1.10
Burns WB City, Oreg. (Silvies River)	1.26	3.37	.84	.77	.67	.96	5.47	2.40
San Joaquin River and Sacramento River basins:								
Huntington Lake, Calif. (Upper San Joaquin River)	2.26	6.88	6.35	5.97	.37	2.15	15.49	8.49
Modesto, Calif. (San Joaquin River)	.19	1.48	1.27	.46	.30	.08	2.94	.84
Calaveras Big Trees, Calif. (Calaveras River)	4.55	17.44	10.45	9.01	.34	2.58	32.41	11.96
Bieber, Calif. (Pit River)	1.17	4.33	2.28	1.84	.62	.60	7.78	3.06
Shasta Dam, Calif. (Sacramento River)	5.30	22.39	2.80	5.72	.71	3.13	30.49	9.56
Red Bluff WB Airport, Calif. (Sacramento River)	.99	2.47	1.03	3.39	.24	.46	4.49	4.09
Bucks Creek PH, Calif. (Feather River)	3.80	24.17	9.50	14.76	.60	2.62	37.47	17.98
Blue Canyon WB Airport, Calif. (American River)	4.45	26.21	10.90	10.02	.55	2.75	41.56	13.32
Sacramento WB City, Calif. (Sacramento River)	.53	3.93	1.23	2.82	.37	.47	5.69	3.66
Hobergs, Calif. (Clear Lake)	2.23	17.62	4.28	15.32	.27	3.24	24.13	18.83
North-coastal California:								
Kentfield (Corte Madera Creek)	1.46	8.49	5.43	7.45	.44	1.81	15.38	9.70
Skaggs Springs Las Lomas (Russian River)	3.55	18.50	5.27	12.08	.54	3.13	27.32	15.75
Richardson Grove State Park (Eel River)	6.01	27.42	6.45	11.25	1.62	4.28	39.86	17.17
Hoopa (Trinity River)	7.63	18.79	7.46	5.87	3.24	2.52	33.88	11.63
Fort Jones Ranger Station (Klamath River)	2.29	5.55	4.06	2.33	1.02	1.13	11.90	4.48
Gasquet Ranger Station (Smith River)	16.06	20.00	8.02	8.81	4.35	5.71	44.08	18.87
Upper Columbia River and Snake River basins:								
Mullan FAA, Idaho (Coeur d'Alene River)	3.97	6.04	1.59	1.66	.46	4.98	11.60	7.10
Pullman 2NW, Wash. (South Fork Palouse River)	1.29	4.10	.81	.41	.41	2.13	6.20	2.95
McCammon, Idaho (Portneuf River)	.50	3.53	.86	.02	.27	.81	4.89	1.10
Hailey Ranger Station, Idaho (Wood River)	1.46	7.75	2.09	2.26	.07	1.52	11.30	3.85
Westfall 4NNW, Oreg. (Malheur River)	.78	2.10	.32	.87	.40	.95	3.20	2.22
Deadwood Dam, Idaho (Payette River)	3.91	8.14	4.56	2.92	.36	4.02	16.61	7.30
Pierce Ranger Station, Idaho (Clearwater River)	5.31	4.07	1.73	.88	1.35	6.87	11.10	9.11
Lower Columbia River basin:								
Pendleton WB Airport, Oreg. (Umatilla River)	1.14	1.37	.72	.56	.44	2.08	3.23	3.08
Sisters, Oreg. (Deschutes River)	1.99	7.53	2.72	.42	.98	1.65	12.24	3.05
Ochoco Ranger Station, Oreg. (Crooked River)	2.32	5.65	1.03	.76	.72	1.44	9.00	2.92
Appleton, Wash. (Klickitat River)	3.64	8.06	3.35	.85	.88	5.74	15.05	7.47

Bonneville Dam, Oreg. (Columbia River)	8.21	10.91	4.45	3.19	1.56	10.91	23.52	15.71
Astoria Experiment Station, Oreg. (Columbia River)	5.43	5.74	5.44	4.06	2.02	13.87	15.91	20.65
Willamette River basin:								
Cottage Grove Dam, Oreg. (Coast Fork)	5.35	8.88	4.03	1.88	1.73	3.93	18.25	7.55
McKenzie Bridge, Oreg. (McKenzie River)	9.62	7.05	12.18	2.50	2.46	13.10	28.77	18.14
Corvallis, Oreg. (Marys River)	3.08	7.46	2.90	1.61	1.20	8.44	13.44	11.25
Three Lynx, Oreg. (Clackamas River)	9.01	13.36	3.91	2.30	1.38	11.31	26.27	15.00
Cherry Grove 2S, Oreg. (Tualatin River)	5.04	8.56	3.21	3.07	1.33	6.72	16.71	11.22
Coastal Oregon:								
Alsea Fish Hatchery (Alsea River)	8.09	14.12	10.14	4.94	1.49	19.24	32.30	25.72
Elkton 3SW (Umpqua River)	4.12	11.05	6.47	4.74	1.93	3.51	21.62	10.20
Crater Lake National Park Headquarters (Rogue River)	10.80	19.46	8.26	4.32	3.28	9.88	38.47	17.53
Williams (Rogue River)	5.19	11.84	4.22	4.50	.97	1.55	21.25	7.02
Illahe 2N (Rogue River)	8.74	21.19	11.50	5.95	3.64	7.24	41.43	16.83
Minor area of flooding in Washington:								
Buckley 1NE (White River)	2.89	3.81	1.82	.79	.36	7.65	8.51	8.81
Greenwater (White River)	4.42	4.93	1.71	.56	.93	13.39	10.98	14.96
Palmer (Green River)	6.88	4.99	2.60	2.04	1.29	13.86	14.25	17.41

THE GREAT BASIN

Minor storms in November and early December brought near-normal precipitation to most of the flood-affected area in the Great Basin. Precipitation was heaviest in the mountain areas in California, where more than 10 inches, occurring mostly as snow, was reported. By December 18 the snowline on the eastern slope of the Sierra Nevada was at an altitude of 6,000 feet above mean sea level; snow depth was 30 inches at the 8,000-foot altitude, while ground conditions were moderately dry in the Truckee River and Carson River basins and other valley areas.

A series of Pacific storms December 18–January 7 began with a cold storm December 18–20 that deposited 2–5 inches of precipitation, mostly snow, in the Sierra Nevada. During the major phase of the storm December 21–23, the incoming warm airmass raised temperatures rapidly, increased wind velocities, and caused torrential rain, as much as 16 inches, in the mountain areas. The warm winds and heavy rains melted most of the new snow that had accumulated at low altitudes and compacted the snow at higher altitudes. From December 26 to January 1, moderately intense cold-type storms swept over the Sierra Nevada, and the resulting precipitation occurred principally as snow. A precipitation total of 33.03 inches for December was recorded at the Mount Rose Highway Station southwest of Reno, Nev., the greatest monthly total ever recorded in Nevada. December precipitation of 30.79 inches was recorded at Meyers Inspection Station, Calif., south of Lake Tahoe.

The storms of January 2–7 and 21–31 were not particularly noteworthy in this region, but, because the ground was saturated from previous rain, the flows in the streams remained high for most of January. Precipitation in December was three to four times normal throughout the region, whereas the precipitation in January was about 150 percent of normal.

SAN JOAQUIN RIVER AND SACRAMENTO RIVER BASINS

The great storm of December 19–23, 1964, in the San Joaquin River and Sacramento River basins in California was preceded by 2 months of wet weather. Precipitation in November was about 200 percent of normal—10–15 inches, mostly snow, in the mountains and 2–5 inches of rain in the valleys—and occurred principally during the periods November 8–13 and 22–29. Precipitation December 1–18 was moderate in the eastern part of the region and low in the valleys. By December 18 the Sierra Nevada areas of the northern San Joaquin River and Sacramento River basins were moderately wet and the snowline in the mountains extended down to about the 5,000-foot altitude. The snowpack at an altitude of 7,500 feet on the western slopes of the Sierra Nevada had an unseasonally high density of about 35 percent (specific gravity of the snowpack expressed as a percentage) and depths of about 30 inches.

The cold storm of December 18–20, the initial phase of the series of storms from December 18 to January 7, deposited snow down to the 3,500-foot altitude. About 5 inches of precipitation occurred in the Mount Shasta area and the upper Feather River and Yuba River basins and about 2 inches in the northern Coast Ranges and in the south-central Sierra Nevada. During the warmer major phase of the December 21–23 storm, 20–25 inches of rain fell in the headwater areas of the Feather River, Yuba River, and American River basins; as much as 15 inches in the upper Mokelumne River and Stanislaus River basins; and more than 7 inches in the upper San Joaquin River basin. Rainfall in the valley areas and adjacent foothills was relatively light, generally less than 5 inches. The warm winds and heavy rains melted most of the new snow at the lower altitudes, but at the higher altitudes the existing snowpack intercepted and retained much of the rain. In the Yuba River basin, for example, the snowline rose to 6,000 feet and snow depth decreased at altitudes of less than 8,000 feet. Snowmelt contributions to the maximum flows, however, were minor. Until December 22, the day of peak runoff, snowmelt is estimated to have added less than an inch of water to the 15 inches of rain that had fallen in the basin, but an additional inch of water from snowmelt increased the volume of runoff in the recession period after the peak.

During the storms of December 24–January 1 rain fell at low altitudes, causing repeated rises on many streams, and snow fell elsewhere. The snowline in the Sierra Nevada and the northern Coast Ranges was as low as 2,000 feet. A small-area storm of high intensity occurred December 26 over the mountain slope south of Oroville and caused record runoff in South Honcut Creek, a Feather River tributary. In parts of the Feather River, Yuba River, and American River basins, the quantity of precipitation during the December storms exceeded that during the floods of December 1955.

Precipitation during the January 2–7 storm was notably heavy in parts of the San Joaquin River and Sacramento River basins; 10–15 inches occurred as rain and snow in the upper Feather River and Yuba River basins and in the Coast Ranges. January 5 an intense local storm crossed the Sacramento Valley north of the town of Red Bluff and caused flood peaks, equaling or exceeding those in December, in some of the small tributaries of the Sacramento

River. The January 21–31 storm was minor; precipitation was less than 5 inches throughout the area. In the northern part of the Sacramento River basin the precipitation in January occurred largely as snow, and at Red Bluff the snowfall during the month was the greatest for any month since 1950. The town of Mount Shasta received above-normal precipitation for the third consecutive month; the 3-month total was 26.17 inches. The total precipitation for November, December, and January, recorded at Blue Canyon Airport (in the American River basin), was 69.13 inches, 40.44 inches greater than normal. Precipitation during December in the Sacramento River basin as a whole averaged 290 percent of normal, and that in the Yuba River basin was about 400 percent of normal. High-altitude areas in the central and northern Sierra Nevada, the Cascade Range, and the northern Coast Ranges received as much as one and a half times normal precipitation during January, but at most valley stations in central and northern California the amounts recorded were below normal.

NORTH-COASTAL CALIFORNIA

Heavy precipitation in November and during the first few days in December, as much as 21 inches in some areas in north-coastal California, caused significant runoff during November, and streams were at moderate stages in early December. The November precipitation occurred principally during the periods November 8–13 and 22–30 and ranged from about three times normal in northern California to about twice normal in the Eel River and Russian River basins. These rains replenished the soil moisture and caused the first surface runoff of the winter season. Precipitation December 1–18 varied from about twice normal in the northern part of the region to near normal in the Russian River basin. This precipitation maintained the saturated soil conditions, and substantial snow accumulated in the higher altitudes of the Cascade Range and the Coast Ranges down to altitudes of about 4,500 feet.

The December 19–23 storm was of unprecedented intensity in the region. The freezing level was about 10,000 feet for most of the period December 21–23, and almost all precipitation was rain. The orographic effects on the precipitation are reflected in the isohyets shown in figure 2, which indicate maximum rainfall on the windward side of the coastal mountain barriers and minimum rainfall in the rain shadows of these barriers. Extreme rainfalls of nearly 50 inches occurred at Ettersburg in the Mattole River basin during December 19–23; 15 inches occurred December 22. More than 25 inches of precipitation occurred during this same period in parts of the Russian River, Eel River, and Smith River basins.

From December 24 through January 1 the flow of warm moist air to the coast was cut off by a high-pressure surge, followed by low pressure and by cold air from the Arctic region. Precipitation occurred generally as snow at altitudes of more than 1,500 feet and as rain at lower altitudes. The January 2–7 storm was marked by a rise in the freezing level to about 3,500 feet. Precipitation was moderate, the heaviest amounts being in the southerly basins, where as much as 15 inches was recorded in the Russian River basin. Runoff was maintained at high levels; in basins south of the Russian River the runoff was sufficient to cause peaks greater than those in December. The January 21–31 storm was generally of minor importance, but streamflow was sustained at moderate levels.

The December precipitation in the basins of north-coastal California averaged about 260 percent of normal, ranging from 210 percent in the Russian River basin to 300 percent in the Klamath River basin. Measurable precipitation occurred on 27 days in December at Covelo in the Middle Fork Eel River basin and on at least 23 days at many stations in the region. In January the precipitation averaged a little above normal; amounts nearly 40 percent above normal were recorded in the upper Russian River basin, but were as low as 70 percent of normal at Fort Bragg.

UPPER COLUMBIA RIVER AND SNAKE RIVER BASINS

General rains in late November replenished soil moisture and caused small rises in most of the streams in the region. The temperature was mild in early December, with widespread rain and snow, but during December 16–18 very cold air of Arctic origin covered much of the Pacific Northwest east of the Cascade Range. Temperatures dropped to minimums of 10°–30°F below zero and maximums of 0°–15°F above zero, causing icing in streams and considerable frost penetration into the ground. December 19 a deep southwesterly airflow brought warm air aloft, moderate temperatures at the ground surface, and snow. The warm subtropical air reached down to the ground surface by December 21, maximum temperatures rose from about 30° to about 60°F above zero, and the freezing level ranged from altitudes of 10,000 to 12,000 feet above mean sea level. Moderate to heavy rain occurred December 21–23. Prior to this warming, the snow depths in the valleys ranged from a few inches at low altitudes to several feet at the higher altitudes. The heavy prolonged rains on the frozen ground and sudden extensive snowmelt produced heavy runoff in streams throughout the region. The precipitation, which was exceptionally heavy for the region, exceeded 2 inches in 24 hours at many stations; 3.39 inches was recorded at Mullan Airport near Wallace, Idaho, December 22. A maximum of 8.14 inches of precipitation for the December 19–23 storm was recorded at Deadwood Dam, about 55 miles northeast of Boise, Idaho. During the period December 24–January 7 temperatures were generally subnormal, and snow fell almost daily. The saturated soils were refrozen, and snow accumulated to depths of 3–12 inches in the lower valleys.

During January 20–26 a series of Pacific storms dropped the freezing level to about 4,000 feet and caused almost daily rain in the valleys and snow at the higher altitudes. After January 26 the freezing level rose to about 8,000 feet and precipitation intensities increased; the heaviest rain occurred January 28–29. Precipitation during the January 21–31 storm was notably heavy in northeastern Oregon, southeastern Washington, and north-central Idaho. As much as 7.38 inches was recorded at Meacham, 20 miles northwest of La Grande, Oreg.; 8.79 inches, 13 miles east-southeast of Walla Walla, Wash.; and 7.71 inches, at Elk River, 40 miles east of Moscow, Idaho. Precipitation exceeding 5 inches occurred also during this period in a small area north of Boise, Idaho; 5.76 inches was recorded at Idaho City. These heavy rains produced recordbreaking floods having recurrence intervals greater than 50 years in some basins, notably the Grande Ronde River basin in Oregon.

December precipitation was above normal throughout the region, ranging from about twice normal in the northern part of Idaho to four to five times normal in the northerly tributaries of the central Snake River basin. The 16.61 inches for December at Deadwood Dam was the maximum reported in the region. At many stations the precipitation for the month was the heaviest on record for December and at some stations exceeded the previously recorded maximum for any month. January precipitation averaged from one and a half to two times normal over most of the region; at Riggins Ranger Station, in north-central Idaho, the total for the month was five times normal and was greater than that for any previous month on record. Snow surveys in late January indicated the water equivalent of the snowpack was more than 150 percent of the 15-year average.

LOWER COLUMBIA RIVER BASIN

The lower Columbia River basin, as outlined in figure 1, includes areas of contrasting climatic characteristics in both Oregon and Washington. The upper part of this basin normally has cool winters with low precipitation, and the lower part, especially that part downstream from Portland, Oreg., has a maritime climate that is mild and moist in winter.

November precipitation was about normal in most of the region but was about 150 percent of normal in the lower valley. The quantity was sufficient to replenish soil moisture and produce small rises in streams in parts of the region. The weather was generally mild in early December, and moderate precipitation occurred, partly as snow. The Wind River basin and adjacent areas in Washington, however, received as much as 12 inches of precipitation December 1–18. Cold Arctic air moving in from British Columbia December 14–15 covered most of the Pacific Northwest by December 18. The interaction of this cold air and the warm moist tropical air from the Pacific Ocean December 18 brought a series of Pacific storms and heavy precipitation that continued until the end of the month. The precipitation December 18–19 occurred as snow, which accumulated in the valleys and added several feet to the snowpack in the Cascade Range. The meeting of cold air from the interior and moist marine air created violent blizzard conditions and heavy snow in the Columbia River Gorge—a near sea-level passage through the Cascade Range. Temperatures in the region rose rapidly December 19–20, and precipitation changed from snow to rain. Total precipitation for the December 19–23 storm ranged from less than an inch at Echo, near Pendleton, Oreg., to more than 10 inches in the northern Cascade Range in Oregon and the lower Columbia River valley; 15.12 inches was recorded at Wind River, Wash., near Bonneville Dam.

The snowpack at medium and higher altitudes retained most of the initial rain; however, as the rains continued with increased intensity, the medium altitude snowpack collapsed, and there was resultant sudden runoff of meltwater. At Government Camp, Oreg., near Mount Hood, for example, at 3,900 feet above mean sea level, the snow depth December 20 was 55 inches, and its water equivalent was 5.44 inches. In the next 24 hours 1.57 inches of rain was added, and the pack was compacted to a depth of 45 inches; by December 23, after an additional 9 inches of rain, only 6 inches of snow remained. Assuming 3 inches of water in the saturated 6 inches of snow remaining December 23, approximately 13 inches of water was available for infiltration and runoff. The low temperatures preceding the storm had frozen the top layers of the saturated soil; consequently, the runoff from rain and snowmelt was rapid at this altitude and caused severe flooding.

The time distribution of snowmelt during the flood period is illustrated in figure 5, which is based on records obtained by Beaumont (1965) at a pressure-pillow snow gage installation. The pressure pillow, a device for measuring the water equivalent of a snowpack, was 12 feet in diameter and was operated by the U.S. Soil Conservation Service near Phlox Point on the south slope of Mount Hood, Oreg., at an altitude of 5,500 feet. The simultaneous data on air temperature, accumulative precipitation, and water equivalent of snow demonstrate the effect of rain on a deep snowpack. The water equivalent of the snowpack increased from 21.18 inches December 18 to 25.3 inches December 21, decreased to about 24 inches December 23 during rain, and then rose to 25.56 inches December 24 as temperatures dropped at the end of the storm. The net increase in

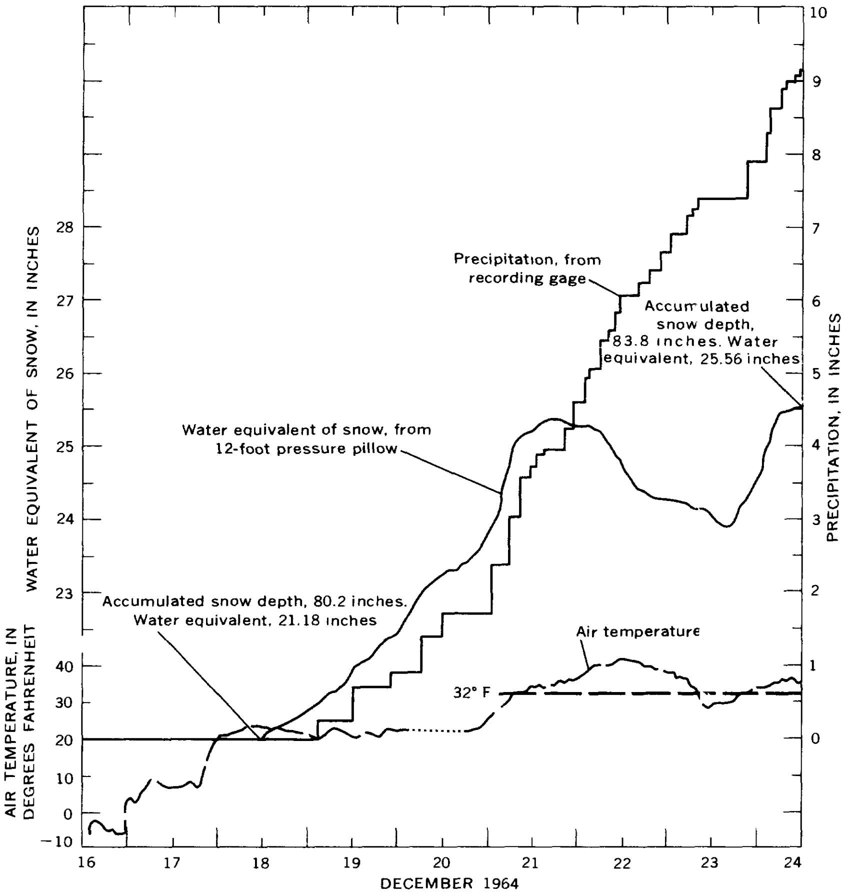

FIGURE 5.—Time distribution of snowmelt, as indicated by simultaneous records of air temperature, precipitation, and water equivalent of snow at pressure-pillow snow gage at Phlox Point on Mount Hood, Oreg., December 16-24, 1964. Modified from Beaumont (1965).

water equivalent was only 4.4 inches during the storm period although 9.2 inches of precipitation was recorded. The balance of 4.8 inches was contributed to infiltration and runoff as a result of some snowmelt and passage of rainwater through the snowpack. This loss of 4.8 inches at an altitude of 5,500 feet contrasts with the net loss of about 13 inches at an altitude of 3,900 feet at Government Camp.

The continuing intermittent storms December 24–January 1 were accompanied by lower temperature, and the precipitation occurred largely as snow. The quantities of precipitation were generally minor, except in the Columbia River Gorge and the lower Columbia River valley, where more than 4 inches was common; 6.09 inches was recorded at Clatskanie, Oreg., 30 miles east of Astoria.

Precipitation during the January 2–7 storm again was relatively minor in much of the region and occurred principally as snow. In the coastal areas of Washington, gale-force winds and the flow of warm moist Pacific air caused heavy snow in the Coast and Cascade Ranges. Snow accumulated in the valley areas also—in the lower valleys of southwestern Washington it accumulated to depths of 5–15 inches. Precipitation in the lower part of the Columbia River valley was more than 3 inches; 6.71 inches was reported at Wind River, Wash. East of the Cascade Range temperatures remained subnormal until January 10, much of the soil stayed frozen, and snow accumulated to depths of 3–12 inches in the lower valleys; by January 19, however, the temperatures had risen and the freezing level also rose. The new series of storms that reached the coast January 19 caused the freezing level to drop to about 4,000 feet during the period January 20–26 and brought heavy snow to most of the region. A sharp warming trend January 26 again raised temperatures, and the precipitation intensities increased. Rain January 28–29 was heavy in the eastern part of the region and in the Cascade Range. Precipitation for the January 21-31 storm was 5.29 inches at Granite in the Blue Mountains in eastern Oregon. The high runoff from rain and snowmelt produced record floods on some streams in the upper John Day River basin in central Oregon. Total precipitation for the January 21–31 storm exceeded 10 inches in the Cascade Range and foothills, and 17.59 inches was recorded at Government Camp, Oreg. For the same period a total of 13.87 inches was recorded at the Astoria (Oreg.) Experiment Station in the lower Columbia River valley.

The total precipitation for December was about three times normal in the eastern part of the region and in the Cascade Range and about 150 percent of normal in the lower Columbia River valley. In

January the total precipitation was more than twice normal in the eastern part and about 150 percent of normal in the lower Columbia River valley.

WILLAMETTE RIVER BASIN

The Willamette River basin received an average of 9.5 inches of precipitation in November on the valley floor and nearly 13 inches in the Cascade Range. This precipitation, which was more than 130 percent of normal, saturated the soils in the basin and produced moderate rises in the streams. Temperatures were moderate during the first half of December and above-normal precipitation fell generally as rain; snow fell at higher altitudes.

Cold Arctic air moving into northeastern Oregon December 14–15 had spread to the Willamette River basin by December 16. Below-freezing temperatures were general, and minimum temperatures in the Willamette Valley ranged from 2° to 12°F above zero. December 18 a major storm, resulting from the confluence of this cold air and warm moist tropical air from the Pacific Ocean, reached the Oregon coast. In the next 24–36 hours precipitation fell principally as snow, which accumulated on the valley floors of the middle and lower Willamette Valley, reached depths of 1 foot in the Coast Range, and added several feet to the snowpack in the Cascade Range. Temperatures rose sharply December 19–20, and the heavy precipitation of December 20–23 occurred as rain and melted a large part of the snowpack below the 5,000-foot altitude. Precipitation December 19–23 exceeded 15 inches at several stations on the west slope of the Cascade Range; 17.90 inches was reported at Marion Forks Fish Hatchery, 60 miles east of Albany, and more than 10 inches was recorded at many stations throughout the region. Daily precipitation exceeded 4 inches at several widely scattered stations; 5.83 inches was reported December 22 at the Marion Forks Fish Hatchery. Because the soils had been saturated by prior rains and some surface layers had been frozen by the low temperatures preceding the storm, the infiltration of water into the soil was minor; thus, runoff from the heavy rain and from the snowmelt was rapid and immediate.

The storms continued during the period December 24 through January 7, but temperatures were lower. The precipitation occurred largely as rain, with some snow at higher altitudes, and was as much as 12.18 inches at McKenzie Bridge, 50 miles east of Eugene, December 24–January 1. The precipitation for the January 2–7 storm was relatively minor.

Temperatures in early January were moderate, and freezing level rose to an altitude of about 10,000 feet by January 19. Another series of Pacific storms reached the coast January 19 and extended over the Willamette River basin by January 20. Freezing level dropped to about 4,000 feet January 20–25, and rain was moderate. After January 25 temperatures rose again and the freezing level also rose. Precipitation intensities increased; daily totals exceeded 2 inches at many stations January 27–29, and 4.28 inches was reported at Oregon State University at Corvallis January 28. In much of the region, the totals for the January 21–31 storm were comparable to those for the December 19–23 storm; they exceeded 15 inches in the Cascade Range (at the town of Detroit and at Santiam Pass) and in the Coast Range (at Summit and the Corvallis Water Bureau station). The runoff from the heavy rain and the melting of much of the snowpack that had accumulated earlier in the month again produced flows nearly as great as the maximum flows in December.

The total precipitation for December ranged from 10 to 35 inches in the Willamette River basin, about twice the normal precipitation in the valley and two and a half times the normal in the Cascade Range. The total precipitation for January was about one and a half times the normal.

COASTAL OREGON

Storms November 1–14 and 21–30 brought heavy precipitation to coastal Oregon. The precipitation averaged about one and a half times the normal for the month in this notably wet region and caused substantial surface runoff. Precipitation for November exceeded 15 inches at many stations; a maximum of 25.27 inches was reported at Valsetz. During the first half of December, temperatures were moderate, rain was frequent, and precipitation was above normal.

Cold Arctic air moved southward December 16 and brought below-freezing temperatures to nearly all parts of coastal Oregon. The confluence of this cold Arctic air and warm moist tropical air from the Pacific Ocean late December 18 started a series of Pacific storms that brought heavy precipitation to the Oregon-northern California coast. This precipitation occurred December 18–19; it fell largely as snow that accumulated to depths of 1 foot in the coastal ranges. By the evening of December 19, freezing levels were rising rapidly, and the precipitation changed from snow to rain. The storms continued through the month, and torrential rains occurred December 19–23. The rains and melting of the snowpack December 19–23 produced high rates of runoff from the saturated and slowly thawing ground, and this caused extreme floodflows in the streams. The precipitation for the December 19–23 storm was as much as 21.19

inches near Illahe in the Rogue River basin in southwestern Oregon; the rainfall December 22 was 8.23 inches. Toward the end of the storm, after the flood peak, colder air caused the precipitation to change from rain to snow at the higher altitudes. The December precipitation of 41.43 inches near Illahe was the maximum reported in the region; the second highest value, 40.25 inches, was reported at Valsetz. Precipitation occurred 27 days or more during the month at nearly all stations.

The January 2–7 storm was relatively minor and, together with intermittent precipitation January 8–11, maintained soils at near-saturation levels. Another series of Pacific storms reached the coast about January 19, and the lowered freezing levels caused some of the January 21–25 precipitation to fall as snow at the higher altitudes. The rainfall intensities increased greatly January 25, and temperatures well above freezing extended to higher altitudes. The rainfall January 28 was 4–7 inches at several points in the coastal area near Newport; 7.44 inches was reported at Otis. The precipitation for the January 21–31 storm was generally less than that for the December 19–23 storm; however, in the central part of the region, from Reedsport on the Umpqua River to Tillamook, the precipitation for the January 21–31 storm was substantially greater —21.40 inches was recorded at Valsetz. In late January, discharge in many coastal streams exceeded that in December and continued to be high until early February.

Precipitation for December and January averaged about one and a half times the normal, although at some stations it was more than twice the normal.

MINOR AREA OF FLOODING IN WASHINGTON

A small area in Washington in the upper White River and Green River basins, centered about 30 miles east of Tacoma (fig. 1) and about 25 miles north of Mount Rainier, experienced severe flooding in January as a result of the January 21–31 storm. However, December precipitation and runoff in the area, though substantial, were not unusual, and the area was not included as part of the vast region affected by the floods resulting from the December 19–23 storm.

Precipitation—nearly 9 inches in November and about 10 inches in December—generally was above normal for this small area; however, 140 and 120 percent of normal for the 2 months was reported at Buckley at the west edge of the flood area. Precipitation for the December 19–23 storm ranged from 4 to 6 inches. After December 24 air temperatures were lower, and precipitation occurred principally as snow. In early January a southwesterly flow of moist air accompanied by gale-force winds caused heavy snow in the foothills and the Cascade Range; snow fell almost daily until January 10. The total precipitation in this small flood-affected area, however, was minor. January 19 a new series of storms reached the area. Precipitation fell largely as snow until January 25 when a sharp warming trend caused a change from snow to rain and an increase in intensity. Heavy rains fell January 27–29. Precipitation for the January 21–31 storm was 13.39 inches at Greenwater in the middle of the area, and 14.75 inches at Cedar Lake just north of the area; 3.62 inches of the 13.39 inches at Greenwater fell on January 28. A daily total of 5.05 inches was recorded January 29 near Palmer. The generalized precipitation distribution for the January 21–31 storm is shown in figure 4. The precipitation for January averaged more than 150 percent of normal throughout the area.

GENERAL DESCRIPTION OF FLOODS

Weather patterns and precipitation during November and early December in parts of California and Nevada and in the Pacific Northwest produced conditions highly favorable to heavy runoff and sediment production. Precipitation in November was greater than normal and caused some minor flooding, notably in coastal areas of northern California and Oregon. The occasional rains in the first half of December maintained soil moisture at high levels. The low temperatures of mid-December froze the top few inches of the saturated soil in many areas, and this situation further increased the potential for rapid runoff and serious erosion. A substantial snowpack that had accumulated in mountain areas prior to the December 19–23 storm provided a potential source of runoff and was augmented by heavy snow December 19–20.

Runoff responded dramatically to the intense warm rains of December 21–23. Streams rose quickly, spilled over their banks, and brought destruction and tragedy to a vast area. Exactly 9 years earlier in December 1955, most of these same streams rampaged wildly and created unprecedented disaster. In many areas in Oregon and northern California, the 1964 floods were greater than those of 1955; some peak stages not only exceeded those of 1955, but closely approached or were even greater than those of the almost legendary 1861–62 floods. The floods of December 1964 did not extend as far south as those of December 1955, but they covered a much larger area in Oregon and Idaho. Also, the floods were of recordbreaking magnitude on many streams in southern Washington, whereas this area experienced only minor flooding in 1955.

Some generalizations may be made concerning the runoff and sediment loads resulting from the December 19–23 storm. The coastal areas of California and Oregon had relatively little snow prior to this storm, and intense runoff resulted from the extremely heavy rains falling on ground having a high soil-moisture content. In the Sierra Nevada the medium and high altitude snowpack prior to the storm was deep. Studies by the Corps of Engineers and the California Department of Water Resources indicated that the warm heavy rain and associated meteorological conditions during the storm supplied only enough heat to "ripen" the snowpack. Consequently, the snowpack became isothermal at 32°F and was sufficiently dense to retain a small percentage of free water in the capillary spaces. As a result, the snowpack in the Sierra Nevada had only a minor effect on runoff. A little meltwater was added to the runoff, and rainwater passed through the pack with little delay. In Oregon, before the warm rains, there was a deep snowpack at higher altitudes in the Cascade Range, but the rainfall in this region was less than that in the Sierra Nevada. Some of the rain, particularly in north-central Oregon, was absorbed by the snowpack, and runoff rates were not as high as they would have been had the snowpack been lighter. In contrast, extensive melting occurred at lower altitudes in the Cascade Range where the snowpack was lighter. Water from snowmelt and from rain falling on frozen ground reached stream channels quickly and with little infiltration loss. This combination resulted in high runoff rates, high erosion potential, and extremely high sediment yields in those areas where the surficial soils had little protection. Conditions were similar in Idaho and southeastern Washington: a relatively light snowpack and frozen ground. The combination of water from snowmelt and from heavy rain in this region also produced runoff at rates that were extremely high.

Storms following the principal storm and floods of December 19–23 sustained streamflows and sediment loads at moderate levels. The January 2–7 storm brought heavy rain to the Sacramento River basin and to the southern part of the north-coastal area in California. The rain produced maximum flows greater than those in December in many streams. The January 21–31 storm, which included warm, heavy rain January 27–29, produced severe floods in north-central Idaho, northeastern Oregon, southeastern Washington, along the Oregon coast, and in small areas near Boise, Idaho, and Tacoma, Wash. Record and near-record flood peaks occurred in many streams in these areas.

The volumes of storm runoff and the high sediment concentrations and loads during the floods of December 1964 and January 1965 are noteworthy. The sediment concentrations and loads generally were far in excess of those previously observed. The total runoff for December and January in many basins, particularly in the coastal areas of northern California and Oregon and in the Willamette River basin, exceeded that for December 1955 and January 1956. Reservoir storage effected substantial reductions in the magnitude of flood peaks and in the damage to many critical areas.

The floods in each hydrologic region of the flood-affected area are described briefly in the sections that follow. The hydrologic boundaries of these regions are shown in figure 1. The various basins in each region are discussed in the downstream order used by the Geological Survey for its annual reports of surface-water and quality-of-water records. Data on flood stages and discharges and maximum suspended-sediment concentrations and loads are summarized in tables 19 and 20.

THE GREAT BASIN

The Great Basin streams discussed in this report include those that drain the east slope of the Sierra Nevada from the Carson River basin north and small closed basins in northeastern California and south-central Oregon. The major basins include those of the Carson and Truckee Rivers in California and Nevada and the Warner Lakes and the Malheur and Harney Lakes in Oregon. The part of the region in the flood area is shown in figure 1, and the location of flood-data sites 1 to 62 is shown in figure 6. The site numbers are those used in table 19, "Summary of Flood Stages and Discharges," and in the station identification in Part 2, Streamflow and Sediment data, of this report (Water-Supply Paper 1866–B).

Runoff from the east slopes of the northern Sierra Nevada was much heavier at higher altitudes than in the lower basins, but peak flows generally were below the record flows of December 1955 or February 1963. The flood of December 1964 was similar to that of December 1955, except that rain intensities and quantities were greater at the lower altitudes in 1955. In northern California and Oregon, however, recordbreaking floods occurred in December 1964. Flows were high again in some Great Basin streams in Oregon in late January 1965. There was no loss of life attributable to the floods of December 1964 and January 1965.

Discharge hydrographs at selected stations in the Great Basin for the period December 1–January 31 are shown in figure 7. They show the time distribution of runoff and the relative magnitude of the peaks at each station.

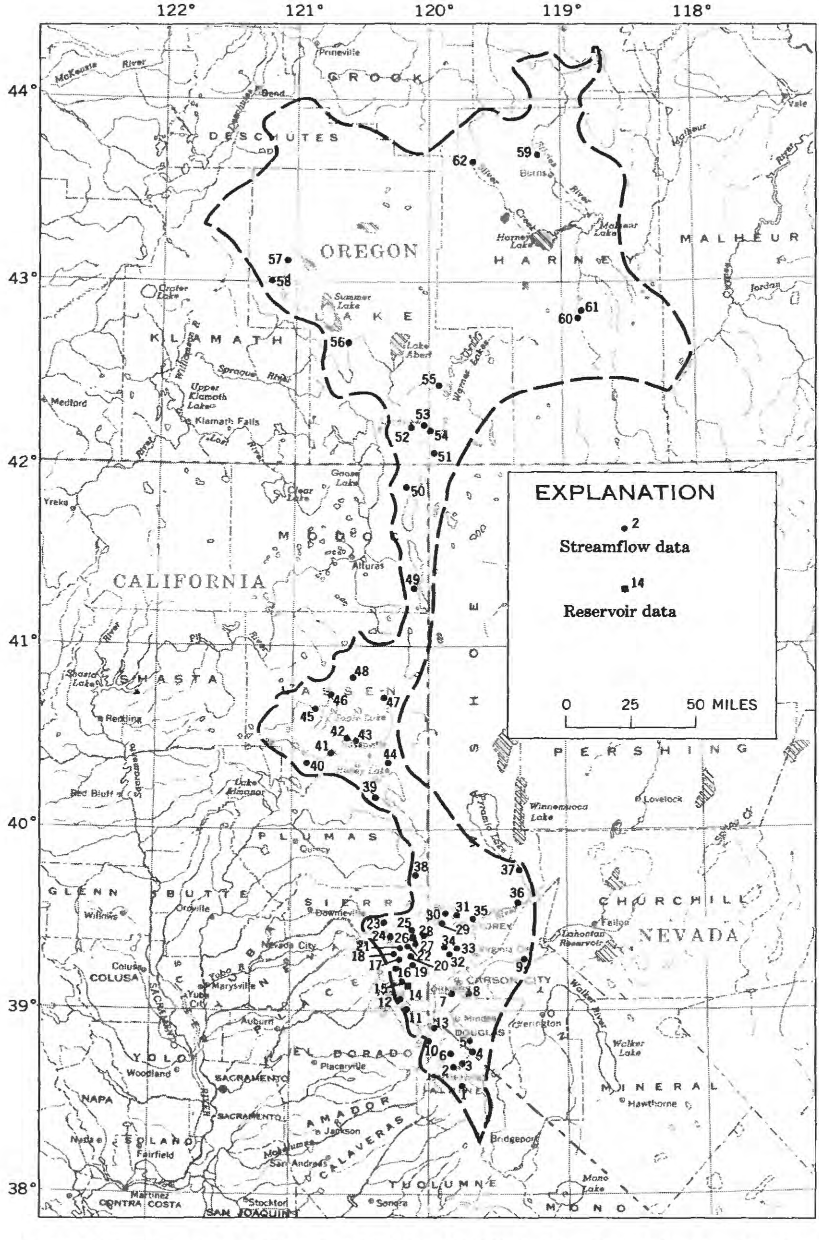

Figure 6.—Location of flood-data sites (1–62) in the Great Basin. Numbers refer to those in table 19.

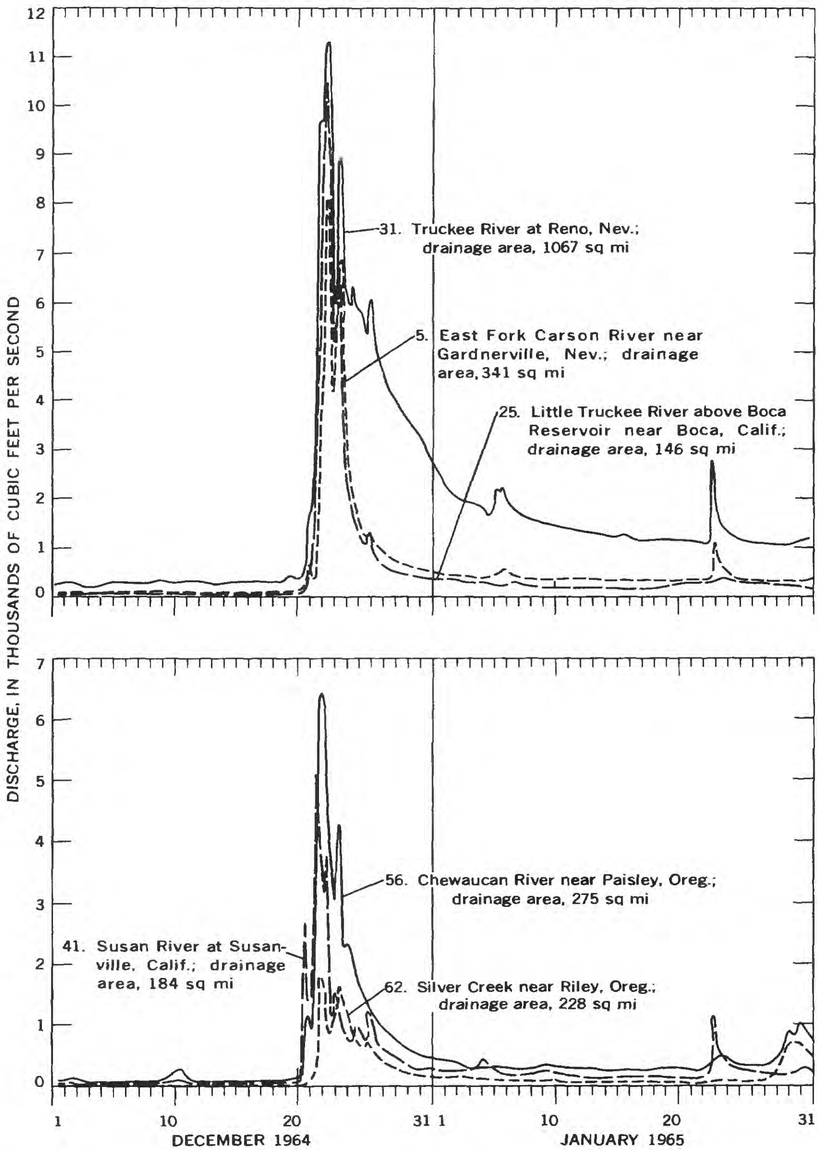

FIGURE 7.—Discharge hydrographs at selected gaging stations in the Great Basin, December 1, 1964–January 31, 1965.

CARSON RIVER BASIN

Floodflows in the Carson River basin were high in December, but the peak discharges were well below the record flows of the disastrous floods of December 1955 or February 1963. Some overflow occurred in the upper Carson Valley. Most of the flooding in the basin occurred, however, in the Minden-Gardnerville area in Nevada as a result of debris reducing the capacities of bridge and culvert openings. The peak flow of 8,230 cfs December 23 in East Fork Carson River near Gardnerville (site 5) was only 47 percent of the record flow in 1955. A total of 13,500 acres of pastureland and hay and grainland was flooded; channels, levees, and agricultural properties sustained the major damages.

Flow in the main stem of the Carson River near Carson City (site 8) exceeded channel capacity, but the peak flow of 8,740 cfs December 25 was only 29 percent of that in the December 1955 flood. Flooding on the Carson River below Carson City was minor. Operation of the Lahontan Reservoir on the Carson River effectively reduced a moderate flood to nondamaging quantities and prevented significant downstream flood damages to the city of Fallon and nearby highly developed irrigated areas.

The flood hydrograph for East Fork Carson River near Gardnerville, Nev., is included in figure 7.

TRUCKEE RIVER BASIN

Local flooding was heavy in the headwater areas of the Truckee River basin in December as a result of copious precipitation. During the December 19–23 storm, precipitation exceeded 20 inches at the higher altitudes, notably in the vicinity of Mount Rose. Part of this heavy precipitation fell as snow or was retained in the snowpack. Floodflows in the upper Truckee River and tributary basins were nearly as great as in 1963. Storage in Lake Tahoe, Donner Lake, and in Prosser Creek and Boca Reservoirs, however, retarded runoff and reduced flooding and damage downstream in Reno, Nev., and in nearby urban areas.

The peak discharge of the Truckee River at Reno (site 31) was 11,300 cfs December 23, at a stage just short of flood stage, as compared to maximum flows of 20,800 cfs in 1955 and 18,400 cfs in 1963. The operation of Prosser Creek and Boca Reservoirs reportedly reduced the peak flow at Reno by about 14,000 cfs, thus preventing record flow, very heavy flood damage, and possible loss of life downstream, particularly in the Reno-Sparks area. The actual floodflows in the Truckee River were generally confined within the flood channel through Reno, but exceeded the channel capacity in Truckee Meadows.

The effectiveness of the three major reservoirs in the Truckee River basin—Lake Tahoe, Prosser Creek Reservoir, and Boca Reservoir at the mouth of the Little Truckee River—in reducing floodflows is further demonstrated by the storage of more than 180,000 acre-feet of flood runoff during the period December 21–24, while runoff in the Truckee River downstream at Reno during the same period totaled only 43,600 acre-feet.

Floodwaters from tributary streams draining the area around

FIGURE 8.—Truckee River overflow into streets at Reno, Nev., during flood of December 23, 1964. Photograph, courtesy Nevada State Journal, Reno, Nev.

Reno and Sparks and local drainage within these cities, however, caused minor flooding in Reno. In both communities minor overflows from the Truckee River flooded some streets (fig. 8). Flood damage costs in the Reno-Sparks area consisted principally of those for flood fighting. Damage to public utilities and facilities in the Truckee River basin included damage to a railroad bridge below Derby Dam, power facilities near Tracy and Lawton Springs, a fuel pipeline, State highways, and a bridge near Wadsworth. Agricultural losses occurred largely in the lower part of the basin and included damage to lands from erosion and debris and damage to stream channels, irrigation structures, and farm improvements. Erosion at the site of the Marble Bluff Dam (an erosion-control dam washed out during a previous flood) on the Truckee River within the Pyramid Lake Indian Reservation was severe and increased the cost of restoring the dam by about $375,000.

In the upper Truckee River basin the flood damages were limited largely to roads; however, there was some overflow onto grazing lands and summer residential areas and some damage to summer homes.

The flood hydrograph for Little Truckee River above Boca Reservoir, near Boca, Calif., and the unadjusted hydrograph for Truckee River at Reno, Nev., are shown in figure 7.

MINOR BASINS IN CALIFORNIA AND OREGON

Recordbreaking discharges occurred December 22–24 in many of the Great Basin streams in northern California and Oregon, notably on principal streams in the Honey Lake, Warner Lake, and Abert Lake basins. Floodflows in some streams in the Silver Lake and the Malheur Lake and Harney Lake basins exceeded or nearly equaled earlier notable floods, such as those of May 1953, December 1955, and February 1963.

Heavy rains on the eastern slope of the Sierra Nevada near Susanville caused severe flooding in the Honey Lake basin. The peak discharge of 5,100 cfs December 22 in Susan River at Susanville (site 41) exceeded the previous maximum flow of 3,900 cfs that occurred in February 1963, and the magnitude was 1.26 times that of a flood having a recurrence interval of 50 years. The flow of 744 cfs in Willow Creek near Susanville (site 43) was slightly less than the record flow of February 1963. Floodwater inundated about 14,300 acres of land for periods as long as a week. Flood losses included damages to farm equipment and supplies, late-planted crops, ditches, irrigation structures, and roads, as well as erosional damage to agricultural lands. The residential and commercial damage in the Honey Lake valley was small.

Floodflows, resulting from heavy rains near the crest of the Warner Mountains, reportedly were greater in the streams tributary to Surprise Valley than were those of December 1955 and February 1963. Streamflow records are too short for comparison, but regional flood-frequency studies indicate about a 50-year recurrence interval for the peak discharge of 682 cfs December 22 in Bidwell Creek below Mill Creek, near Fort Bidwell (site 50). Flood losses consisted principally of damage to agricultural areas, erosion of stream channels, and minor residential damage.

In the Warner Lakes basin in Oregon, the floods of December 23 on all major streams were the greatest in magnitude for periods of record beginning as early as 1910. The peak flows of 9,420 cfs in Deep Creek above Adel (site 54) and 11,000 cfs in Honey Creek near Plush (site 55) were nearly twice those of February 1963, the previous maximum recorded floods. The magnitudes of these floods were 2.23 and 3.54 times those of floods having recurrence intervals of 50 years. Agricultural losses caused by the floods included loss of livestock and hay and feed and damage to structures. Damage to transportation facilities was extensive and resulted largely from washouts of highways, bridges, and culverts.

The maximum flow of 6,490 cfs December 22 in Chewaucan River near Paisley, Oreg. (site 56), in the Abert Lake basin far exceeded the historic peak discharge of 4,000 cfs in 1909 and any that had occurred at the station in a 50-year period of record. Flood losses in the basin totaled more than $2.3 million, of which more than $1.1 million resulted from damages to transportation facilities such as roads, highways, and bridges. Agricultural losses were heavy and included loss of hay, feed, and more than 1,200 head of livestock, together with damage to structures and irrigation facilities. Several small homes were destroyed in Paisley.

Floodflows in the Silver Lake and the Malheur Lake and Harney Lake basins were near the maximums of record, except for the Silvies River near Burns (site 59) for which the flow of 3,130 cfs December 23 was only 63 percent of the previous maximum flow of 4,960 cfs in April 1952. Damages in the Silvies River basin were more than $1.3 million, of which about 90 percent was agricultural—largely loss of hay and feed. Some residential and commercial losses occurred in the city of Burns. County roads, streets in the city of Burns, and roads in the Malheur National Forest were damaged or washed out.

The flood hydrographs for Susan River at Susanville, Calif., and for Chewaucan River near Paisley and Silver Creek near Riley, Oreg., are shown in figure 7.

SAN JOAQUIN RIVER AND SACRAMENTO RIVER BASINS

The area in the San Joaquin River and Sacramento River basins

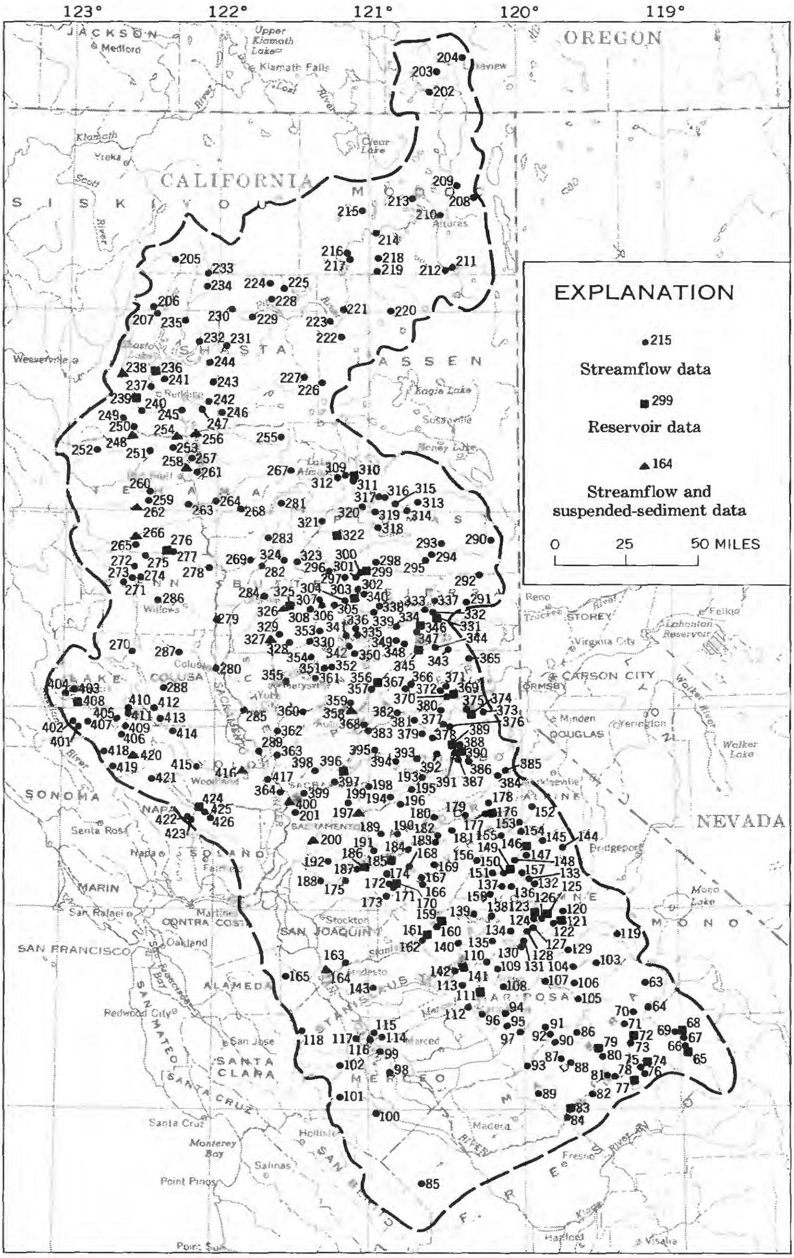

FIGURE 9.—Location of flood-data sites (63–426) in the San Joaquin River and Sacramento River basins. Numbers refer to those in tables 19 and 20.

that was affected by the floods of December 1964 and January 1965 includes that part of the San Joaquin River basin east of the main stem of the river in the San Joaquin Valley and north of Fresno, Calif., and the entire Sacramento River basin. In addition, the Goose Lake basin in Oregon and California, now a closed basin, was included in this hydrologic region. The part of these basins in the flood area is shown in figure 1, and the location of sites 63 to 426, for which stage, streamflow, and some suspended-sediment data are available, is shown in figure 9.

In the San Joaquin River and Sacramento River basins, as in the Great Basin, runoff was heavy at the higher altitudes in the Sierra Nevada and in the coastal ranges. Precipitation on the valley floor was relatively small as shown on the isohyetal maps (figs. 2–4). The principal floods occurred December 22–24 with generally high runoff throughout the northern part of the region. In some streams in the Sacramento River basin, the floodflows were of greater magnitude but of shorter duration than those during the floods of December 1955. Extreme floods occurred also in some basins in the region as a result of intense rains in early January.

Flood-control operation of many major reservoirs, such as Shasta Lake, Folsom Lake, Camanche and New Hogan Reservoirs in the Mokelumne River and Calaveras River basins, the detention storage above the partly completed Oroville Dam on the Feather River, and conservation operations of other reservoirs reduced downstream flows generally to the capacity of flood-control channels. Thus, despite high flows in most mountain and foothill streams, floodflows in the Sacramento River and in major tributaries generally were confined within project levees or in bypasses. On the valley floor, flooding occurred largely on lands between project levees or in bypasses and lands not protected by levees, but overflows from other tributary streams caused extensive flooding. At the crest of the flood, Folsom Lake on the American River fully absorbed an abnormally high flood wave caused by the breaching of the partly completed Hell Hole Dam on the Rubicon River. This flood wave caused severe damage at points along the downstream canyon of that river.

Severe flooding occurred in the communities of Chester (which is near Lake Almanor), Downieville, and Coloma (which is 6 miles northwest of Placerville), in the Sierra Nevada, and damage was heavy in the mountain areas. Many towns and cities along the Sacramento River and tributaries were threatened with high water, but flooding was nominal. The Corps of Engineers estimated that 383,500 acres of land was inundated in the Sacramento River basin

(161,000 acres in mountain areas and 222,500 acres on the valley floor) and 71,900 acres was inundated in the San Joaquin River basin (1,700 acres in mountain areas and 70,200 acres on the valley floor). Flood damage in the region was nearly $44 million, but no lives were lost as a result of the floods.

Suspended-sediment concentrations in streams in the San Joaquin

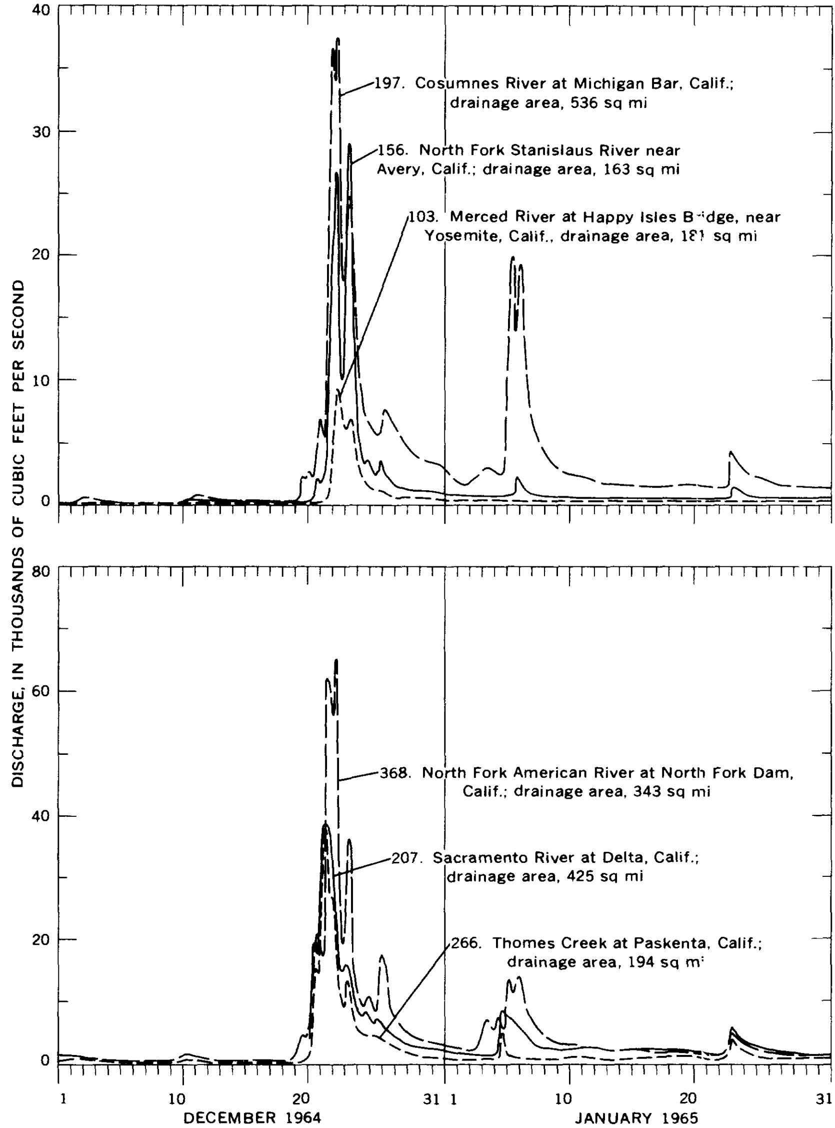

FIGURE 10.—Discharge hydrographs at selected gaging stations in the San Joaquin River and Sacramento River basins, December 1, 1964–January 31, 1965.

River basin were generally lower than the concentrations in streams in the Sacramento River basin. For example, the Cosumnes River at Michigan Bar (site 197) reached a maximum concentration of 3,400 ppm January 6, whereas the concentration in Thomes Creek at Paskenta (site 266) reached a high of 76,000 ppm December 22.

The discharge hydrographs at selected stations in the San Joaquin River and Sacramento River basins (fig. 10) illustrate the relative

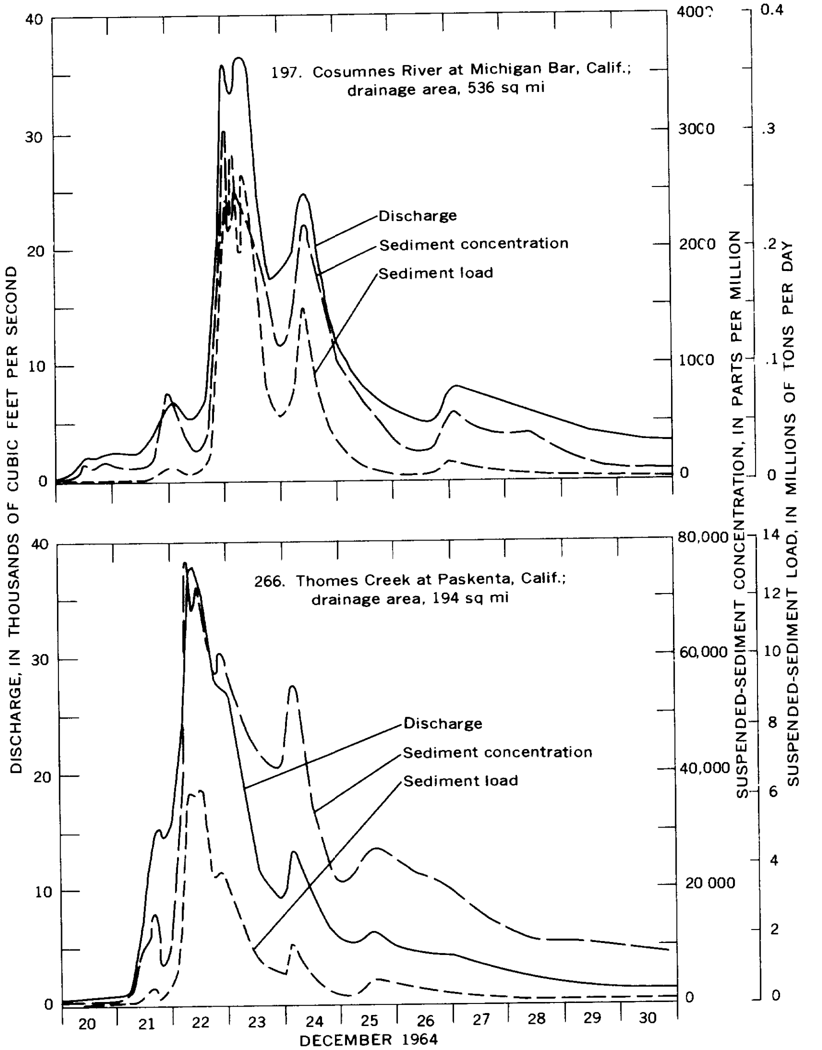

FIGURE 11.—Graphs of suspended-sediment concentration and load and stream discharge at selected stations in the San Joaquin River and Sacramento River basins, December 20–30, 1964.

magnitude of the floodflows during the period December 1–January 31. Graphs of suspended-sediment concentration and loaded and stream discharge at selected stations in these basins for the period December 20–30 are shown in figure 11.

SAN JOAQUIN RIVER BASIN

In the upper San Joaquin River basin, public-utility reservoirs, operated for the generation of hydroelectric power, contained most of the runoff of the main river and its tributaries. This storage resulted in a peak flow of only 9,000 cfs into Millerton Lake on the San Joaquin River. The outflow from Millerton Lake was reduced to 69 cfs, thereby increasing the ability of the lower part of the river to carry the flow from downstream tributaries. Flows in the headwater streams were not outstanding, although the maximum flows of 2,490 cfs in North Fork San Joaquin River below Iron Creek (site 63) and 9,680 cfs in San Joaquin River at Miller Crossing (site 64) were nearly two-thirds of the maximums for the period of record. Damages were limited largely to Forest Service facilities in the mountainous areas. About $2 million in flood damage on the valley floor upstream from the Merced River was prevented by the upstream reservoir storage in the San Joaquin River basin, including the storage of more than 220,000 acre-feet of water in Millerton Lake behind Friant Dam during December and January.

In the lower San Joaquin River basin, stages and flows were fairly low in the Fresno and Chowchilla Rivers and in the smaller streams in Merced County that drain the Sierra Nevada watersheds of relatively low altitude. Flows from west-side tributaries of the river also were minor. Flood losses along the lower San Joaquin River were limited largely to damage to levees and loss of crops in the flood-plain area between the levees. Overflows from Bear, Mariposa, and Deadman Creeks in Merced County inundated about 14,000 acres of agricultural land; damaged levees, roads, ditches, and other improvements; and caused the loss of pasture and of barley, oats, and alfalfa crops.

The principal tributaries of the San Joaquin River—the Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Cosumnes Rivers—all had high peak discharges. Damage to roads and highways constituted most of the losses in the headwater areas of these streams. The most notable damage in these areas occurred in the upper Merced River basin where campsites in Yosemite National Park were flooded and access highways were washed out. The peak flow of 9,240 cfs December 23 in Merced River at Happy Isles Bridge (site 103) approached the record flow of 9,860 cfs in December 1955, but at downstream sites, as at Bagby (site 108), upstream from Lake McClure, the peak flow of 33,800 cfs December 23 was only a little more than a third of the 1955 flow. Lake McClure at Exchequer Dam was low at the beginning of the flood; the December floodflows were fully contained and only nominal flows were released. In early January the reservoir filled completely, and the peak outflow measured at Merced Falls (site 112) was 17,100 cfs January 7, as compared to the record flow of 47,700 cfs in 1911 prior to construction of the dam. Flood damages to facilities and structures were heavy at the construction site of the New Exchequer Dam, just downstream from Lake McClure.

Flood-control operation of Hetch Hetchy, Cherry Valley, and Don Pedro Reservoirs in the Tuolumne River basin provided effective control of heavy flood runoff from headwater areas. The peak flows in these headwater streams were lower than the record flows of December 1955 or February 1963. At Don Pedro Reservoir the peak inflow of 43,400 cfs December 23 was reduced to a controlled outflow on that day of 6,790 cfs recorded above La Grange Dam (site 142); on January 7, after the early January storm, the maximum outflow was only 8,450 cfs. Flows below La Grange Dam were generally confined in the channel, and only minor flooding of agricultural land occurred.

Heavy rains and some snowmelt in the upper Stanislaus River basin caused two substantial flood peaks, December 23 and 24; the peaks were 24–30 hours apart, and the highest peaks generally occurred December 23. The first flood wave was successfully controlled by storage in upstream reservoirs and in Melones and Tulloch Reservoirs in the foothill area. December 23 the peak inflow to Melones Reservoir (site 159) was 48,700 cfs, about 49 percent of the peak inflow of December 23, 1955, but the outflow was only 5,750 cfs. The outflow from the downstream Tulloch Reservoir to the lower part of the river was about 10,000 cfs. The second flood wave, however, filled the reservoirs, and peak outflow December 24 from Melones Reservoir was 38,700 cfs. At Tulloch Reservoir the December 24 outflows were controlled to 41,000 cfs; this outflow was about 65 percent of the peak flow in December 1955, which happened prior to construction of this reservoir. Channel storage further reduced the downstream flood peak to 32,800 cfs at Ripon (site 163). The floodflows caused the breaching of a Federal project levee on the left bank near the junction of the Stanislaus and San Joaquin Rivers and overtopping and damaging of many private levees. About 11,400 acres of highly productive agricultural aland was inundated, and damages were reported in the towns of Ripon, Riverbank, and Oakdale. Flood damages included losses of truck and specialty field crops, walnut and other orchard crops, poultry and livestock; damage to farm improvements, land and supplies; residential losses from flooding; commercial and industrial losses; damage to sewage disposal plants, public parks, levees and roads; and costs of flood fighting. In upstream areas public facilities in Calaveras Big Trees State Park and Stanislaus National Forest also were damaged.

Suspended-sediment concentration in the San Joaquin River at Vernalis (site 164), downstream from the Stanislaus River, reached a maximum of 2,490 ppm December 25. The suspended load for that day was 54,100 tons, a maximum for the period 1956–64. The discharge for the day was only 14,000 cfs, less than two-thirds of the sustained flows that occurred in January as a result of runoff from rain, controlled releases from reservoirs, and return flows from overbank flooding.

Peak flows in streams between the Stanislaus River and Mokelumne River basins, including the Calaveras River and Littlejohn, Duck, and Bear Creeks, were lower than in December 1955 or April 1958 and generally were controlled or confined by flood-control levees. Overflows were minor along these streams, and only about 200 acres of agricultural land was flooded. The peak discharges of 4,800 cfs December 23 in North Fork Calaveras River (site 168) and 7,940 cfs January 6 in South Fork Calaveras River near San Andreas (site 166) indicate that these headwater flows were 77 and 45 percent of the maximum flows in December 1955. The Calaveras River flows were contained in the recently completed New Hogan Reservoir, and peak flow at the Jenny Lind station (site 173) downstream was only 2,570 cfs December 23, as compared to the record flow of 50,000 cfs in 1911, before construction of Hogan Reservoir. Farmington Reservoir on Littlejohn Creek and levee and channel improvements on Bear Creek functioned effectively and prevented substantial damage to agricultural and suburban developments near Stockton. Flood losses included agricultural damage through loss of crops and pasture, bank erosion, and silting of farmland; industrial losses, such as damage to power facilities on Bear Creek; and public-facility losses through damage to levees and to the Stockton sewage disposal plant.

The Pardee and Camanche Reservoirs on the Mokelumne River provided full control of floodflows. There was no flooding or flood damage downstream from Camanche Dam, because the controlled releases were less than the channel capacity of the river. The peak flow of 29,700 cfs December 24 in Mokelumne River near Mokelumne Hill (site 184) was 88 percent of the record flow of 33,700 cfs in

December 1950, and the peak inflow to Pardee Reservoir was 32,100 cfs. Despite extensive storage in Pardee Reservoir and the upstream Salt Springs and Lower Bear River Reservoirs, the peak outflow from Pardee Reservoir and the inflow to Camanche Reservoir was 28,400 cfs. However, the controlled outflow from Camanche Reservoir was only 151 cfs during the critical flood period; the outflow was increased to a maximum of 2,900 cfs December 31 so that the flood-control space in the reservoir could be evacuated. Some flood damage occurred upstream from Camanche Reservoir—heavy spillway flows at Pardee Dam caused rockfalls in the spillway gorge below the powerhouse and backwater upstream at the powerhouse.

Floodflows in the Cosumnes River basin, though heavy, were less than the record flows of December 1955 or February 1963. There are no large impoundments in the basin, however, and the heavy flows caused a large part of the flood damage in the lower San Joaquin Valley. The peak discharge of 37,500 cfs December 23 in Cosumnes River at Michigan Bar (site 197) was 89 percent of the maximum flow in December 1955. Overbank storage downstream along the river caused attenuation of the peak, and the peak discharge at McConnell (site 200) was only 32,200 cfs, 60 percent of that in 1955. Flooding occurred along a 30-mile reach of the Cosumnes River from Michigan Bar to the mouth of the river and along tributaries. Commingling of floodwaters from the Cosumnes River and Deer Creek caused extensive flooding in the vicinity of Wilton. The Corps of Engineers estimated that about 35,200 acres of land in the basin was inundated. The areas flooded were predominantly agricultural, used principally for dairying, orchards, pastures, and field crops. The heavy agricultural losses consisted primarily of damages to fields, structures and facilities, roads, and private levees. Other losses included damage to public roads and levees and to gas wells, pipelines, and appurtenances. Suspended-sediment concentrations in Cosumnes River at Michigan Bar (site 197) reached a high of 3,040 ppm December 22, and the concentrations remained above 2,000 ppm for about 17 hours. The maximum suspended-sediment concentration during the flood period, however, was 3,400 ppm January 6, although the peak flow and daily suspended-sediment load were less than those in December. The maximum suspended-sediment load transported was about 168,000 tons December 23. Graphs of suspended-sediment concentration and load and stream discharge in Cosumnes River at Michigan Bar during the period December 20–30, 1964, are shown in figure 11.

In the Morrison Creek basin near Sacramento, high flows caused flooding of about 7,700 acres of agricultural land in the lower reaches of Morrison and Laguna Creeks. The peak discharge in Morrison Creek near Sacramento (site 201) was 1,040 cfs December 23, as compared to 1,320 cfs in October 1962; greater flows probably occurred in December 1955. Flood losses consisted principally of loss of crops and damages to farm equipment, machinery, and roads.

The flood hydrographs for Merced River at Happy Isles Bridge, near Yosemite, North Fork Stanislaus River near Avery, and Consumnes River at Michigan Bar for the period December 1–January 31 are included in figure 10.

GOOSE LAKE BASIN

Flood runoff was heavy in streams tributary to Goose Lake in the closed Goose Lake basin in Oregon and California. The peak discharges were substantially less than the maximum flows of record, but were generally comparable to high flows occurring in recent years. In Drews Creek near Lakeview (site 202) the peak discharge of 1,240 cfs December 22 exceeded the peaks of 1938, 1952, 1956, and 1958, but was considerably less than the March 10, 1910, maximum flow of 3,000 cfs. However, inflow December 22–24 into Drews Reservoir upstream occurred at an average rate of more than 3,000 cfs, and about 18,500 acre-feet of water was stored. The heavy flows in the Goose Lake basin caused flooding of about 1,000 acres of land along many small creeks. Flood losses were limited largely to damage to agricultural land, levees, and irrigation facilities. Local flooding isolated the city of Lakeview, Oreg., for several days and inundated about 50 homes.

SACRAMENTO RIVER BASIN UPSTREAM FROM FEATHER RIVER

Major floods occurred December 22 and 23 in the Sacramento River basin upstream from Shasta Dam. The peak discharge of 38,800 cfs December 22 in Sacramento River at Delta (site 207) exceeded the record flow of 37,000 cfs in December 1955. However, a peak discharge of 58,000 cfs had occurred February 28, 1940, at a site at Antler, about 5 miles downstream and now inundated by Shasta Lake, where the drainage area was about 8 percent larger. In the Pit River basin, storage in public-utility and water-conservation reservoirs significantly reduced floodflows in the main river and its principal tributaries. Peak discharges in the McCloud River basin were about 60 percent of those in December 1955. The peak inflow of 187,000 cfs December 22 was fully controlled by Shasta Lake and was only 8,000 cfs less than the record inflow of

December 22, 1955, and is comparable to the record flow of 186,000 cfs at Keswick (site 237) in February 1940, prior to regulation by Shasta Lake. Because the outflow from Shasta Lake, however, was controlled to about 6,000 cfs during the most critical period of the flood, the outflows at Keswick (site 237) downstream reached a maximum of only 54,000 cfs December 27. The principal flood peaks occurred in December, but in the upper Pit River basin runoff was heavy again in late January. Flood damage upstream from Shasta Lake was extensive. Highways were damaged severely. More than 47,000 acres of agricultural land was inundated, including 27,200 acres of pasture, alfalfa, and meadow haylands in Big Valley, about 70 miles east of Shasta Lake. At Dunsmuir and at other locations along the Sacramento River the residential, industrial and utility damage was heavy; and Forest Service facilities along the river also were heavily damaged. Industrial and utility damage was heavy in the Pit River basin from Big Valley to Shasta Lake and in the McCloud River basin. Damage was largely to power facilities, including coffer dams of a hydroelectric power project under construction. Severe damage to Forest Service facilities and levee and

FIGURE 12.—Kenyon Creek in South Redding, Calif., as floodwaters overtop a private bridge, December 22, 1964. Photograph courtesy Redding Record-Searchlight.

FIGURE 13.—Gaging station on Battle Creek downstream from Coleman Fish Hatchery near Cottonwood, Calif., isolated by floodwaters, December 22, 1964. Photograph, courtesy of R. E. Whitman, Water Resources Division, U.S. Geological Survey.

bank erosion constituted the principal public-utility damage in the Pit River basin.

In the 40-mile reach of the Sacramento River between Shasta Dam and Red Bluff, tributary inflow was very heavy (figs. 12 and 13), and there were record or near-record flows in several streams. The resulting peak discharge of 170,000 cfs December 22 at the Sacramento River gaging station near Red Bluff (site 258) was the greatest flow since construction of Shasta Dam in 1949. Without the streamflow regulation provided by Shasta Lake and Whiskeytown Lake the peak discharge at the Red Bluff gage would have been greater than the destructive flood of February 1940, which had a peak discharge of 291,000 cfs. Flood peaks on tributaries of the Sacramento River between Shasta Dam and the Feather River were large, and previous maximums were exceeded by Clear, Cottonwood, Elder, Thomes, Big Chico, and Butte Creeks. Records encompass 35 years for Big Chico and Butte Creeks. The maximum flow of 37,800 cfs December 22 in Thomes Creek at Paskenta (site

266) was 160 percent of the flow for December 1955, which had been the previous maximum in a 45-year record. The recently constructed Black Butte Reservoir on Stony Creek (site 276) reduced a peak inflow of 44,300 cfs December 23 to a peak outflow of 19,400 cfs December 25. Minor flooding occurred in the reach of the Sacramento River from Shasta Dam to Red Bluff, but about 43,600 acres of land was flooded between Red Bluff and Colusa. Flood losses in this latter area were extensive and included damage to agricultural land and facilities; levees and channels; marinas, resorts, parks, and highways; and commercial facilities, stock, and equipment. About 1,000 sheep were drowned near Chico.

The diversion, below Butte City, of floodflows to the Sutter bypass and thence to the Yolo bypass under standard flood operation procedure reduced the peak flow in the main Sacramento River at Colusa to about a third of that at Butte City. Sacramento River flows downstream from diversions to flood bypasses were somewhat less than previous maximums.

An intense local storm January 5 crossed the Sacramento Valley north of Red Bluff and caused flood peaks in some small tributaries of the Sacramento River that equaled or exceeded those in December.

Suspended-sediment concentrations were high December 22 in Sacramento River tributaries between Shasta Lake and Red Bluff, and concentrations were in excess of 10,000 ppm for several hours in Middle Fork Cottonwood Creek near Ono (site 248). Concentrations in Sacramento River near Red Bluff (site 258) reached 4,520 ppm December 22, and the maximum daily suspended load transported was 876,000 tons on that same day. Downstream from Red Bluff, suspended-sediment concentrations reached a maximum of 76,000 ppm December 22 in Thomes Creek at Paskenta (site 266), a west-side tributary. This concentration was the highest observed in California streams during the flood, but may have been exceeded in a few other streams. Concentrations in Thomes Creek exceeded 10,000 ppm most of the time from December 21 through December 29 and again on January 5. The maximum daily suspended load transported in Thomes Creek was 5,070,000 tons December 22.

Flood hydrographs for Sacramento River at Delta and Thomes Creek at Paskenta for the period December 1–January 31 are shown in figure 10. Graphs of suspended-sediment concentration and load and stream discharge in Thomes Creek at Paskenta for the period December 20–30 are shown in figure 11.

FEATHER RIVER BASIN

Record and near-record floodflows occurred in many streams in the Feather River basin as a result of the heavy precipitation during the December 19–23 storm. The storm precipitation exceeded 20 inches over most of the basin, as shown by the isohyetal map (fig. 2), and 30.43 inches was observed at the Stirling City Ranger Station in the North Fork Feather River basin. The stage on Middle Fork Feather River near Merrimac (site 296) December 22 was more than 4 feet higher than those in December 1955 and February 1963; the peak discharge of 86,200 cfs was 132 percent of that in 1963, the previous maximum, and 1.3 times the magnitude of a flood having a recurrence interval of 50 years. The gaging station was destroyed. Flows in North Fork Feather River at Pulga, in North Fork tributaries, and in West Branch Feather River near Paradise also exceeded previous maximums.

Flooding along North Fork Feather River upstream from Lake Almanor inundated a large part of the town of Chester and about 220 acres of adjacent land. Flood losses included damage to about 260 homes, to about 50 stores, and destruction of a bridge on State Highway 36. Failure of a levee along Indian Creek caused flooding of about 420 acres of land in Indian Valley. Overflow of Spanish Creek in the Quincy area caused flooding of about 140 acres of land and damage to levees, residences, and tourist facilities. An additional 120 acres of land was flooded by overflows from minor Feather River tributaries upstream from Oroville.

At Oroville the peak hourly inflow to the reservoir of the partly completed Oroville Dam on the Feather River (site 325) was about 252,000 cfs December 22, the greatest flow recorded at this site in a 65-year record. This flow exceeded the previous maximum of 230,000 cfs in 1907. At the Oroville Dam, under construction by the State of California as part of the California Water Project, the embankment had been built to a height of 395 feet and, with its two ungated diversion tunnels, was designed to operate as a detention reservoir. The temporary detention greatly reduced the outflow, and a peak flow of 158,000 cfs was recorded at the gaging station downstream at Oroville (site 326) December 23, about 17 hours after the time of peak inflow. Farther downstream, at Yuba City, the flood stage in the Feather River was about 6 feet below the record stage in December 1955. In the reach from Oroville to Marysville, flooding occurred along the Feather River to a maximum width of about 2½ miles, but the floodwaters were contained generally between project levees or high ground. About 13,500 acres of agricultural land, used principally for orchards, grain crops, alfalfa, and dairying, were flooded. An additional 6,500 acres of land was flooded in the Jack and Simmerly Sloughs area north of Marysville, and orchards, pastures, and riceland were inundated, livestock was destroyed, and a meat-packing and processing plant was severely damaged.

Suspended-sediment concentrations in Feather River at Oroville (site 326) reached a maximum of 7,700 ppm December 25, nearly 60 hours after attainment of the maximum controlled outflow. The maximum daily suspended-sediment load of 711,000 tons transported December 25 was less than half of the load February 1, 1963. At the gaging station downstream near Gridley (site 327) the mean daily concentration reached a maximum of 1,340 ppm December 25, but the maximum daily suspended load transported was 527,000 tons December 23.

An unusually heavy local storm occurred December 26 in the Honcut Creek basin, tributary to the Feather River between Oroville and Yuba City. At the gaging station on South Honcut Creek near Bangor (site 330) the peak discharge December 22 was 4,350 cfs, about 53 percent of the maximum in a 14-year record; but December 26 the heavy runoff from the storm resulted in a peak discharge of 17,600 cfs, more than twice the previous maximum of 8,280 cfs. A similar extreme flow occurred in North Honcut Creek near Bangor. No other gaged streams in the area were affected significantly by this storm. Flooding along Honcut Creek was limited to the vicinity of Honcut, and about 500 acres of land was flooded when a levee was overtopped.

Flood runoff reached recordbreaking levels in the Yuba River basin. Downstream gaging stations in North Yuba and South Yuba Rivers had peak discharges greater than any recorded in the past 62 years; and record flows occurred in several upstream tributaries. The peak flow of the Middle Yuba River, however, was less than in December 1955 and February 1963, because of storage in the just completed Jackson Meadows Reservoir. The high flows in North Yuba River caused backwater in Downie River that resulted in flooding of basements of most of the dwellings and commercial buildings in Downieville. State Highway 49 and Forest Service recreational facilities along the river were also severely damaged. High flows in the South Yuba River caused damage to the Washington Diversion Dam near Washington and to Interstate Highway 80 and secondary roads between Soda Springs and Lake Spaulding.

Englebright Reservoir and numerous irrigation and power reservoirs in the Yuba River basin stored about 122,000 acre-feet of water during the floods. Nevertheless, the maximum flows of 171,000 cfs at 2300 hours December 22 in Yuba River at Englebright Dam (site 351) and 180,000 cfs at 2400 hours at the gaging station near Marysville (site 355) were about 20,000 cfs greater than previous maximums. Downstream from Englebright Dam flooding occurred between the levees from the foothills to Feather River, and about 4,700 acres of farmland, principally orchards, was inundated. Some of the flooded farmland was devoted to grains, alfalfa, row crops, and dairying. The Daguerre Point debris-control dam, 10 miles upstream from Marysville, was partly washed out.

The great flows in the Feather and Yuba Rivers created much apprehension in the Yuba-Marysville area at the junction of the two rivers. Yuba City was the scene of a tragic disaster during the 1955 flood when a levee break resulted in 38 drownings. Several hundred residents of Yuba City left their homes, and thousands more were prepared to evacuate. Fortunately there were no levee failures. Because of the reduction of the maximum flow and attenuation of floodflows in the Feather River through detention by Oroville Dam, the combined flow below the junction of the two rivers was far less than it had been in 1955. The resulting peak discharge in the Feather River at Nicolaus (site 362), about 16 miles downstream, was 281,000 cfs December 23, only 79 percent of the record flow of 357,000 cfs December 23, 1955. From Marysville to the mouth the flooding was limited to lands between levees. About 5,700 acres of land was inundated in this reach, and the high flows caused erosion damage to levees and damage to orchards, pastures, and other agricultural lands.

Floodflows in the Bear River basin were completely contained in the new Rollins and Camp Far West Reservoirs. The control effected reduction in peak outflows to 8,190 cfs December 27, 1964; and 12,700 cfs January 6, 1965, in Bear River near Wheatland (site 360). In contrast the peak discharge in December 1955 was 33,000 cfs. Flooding in the basin was minor. Flows generally were confined within levees below Camp Far West Dam, but about 1,000 acres was flooded along Yankee Slough downstream from Wheatland, and about 750 acres of pastureland was covered by floodwaters from Reeds and Hutchinson Creeks.

SACRAMENTO RIVER BASIN DOWNSTREAM FROM FEATHER RIVER

At the confluence of the Sacramento and Feather Rivers the floodflows from the Feather River, which reached a peak discharge of 281,000 cfs at Nicolaus (site 362), commingled with Sacramento River overflow coming down the Sutter bypass. Most of the floodwater spilled over the Fremont weir into the Yolo bypass. The flow remaining in the Sacramento River reached a peak discharge of 74,200 cfs at Verona (site 363) December 25, about 94 percent of the record flow of March 1940. East-side tributaries of the Sacramento River between the Feather and American Rivers, principally the Coon Creek group, briefly inundated about 7,700 acres of agricultural land used primarily for dry pasture and grain crops. Along the Sacramento River between Verona and Sacramento, however, residential and resort properties suffered flood damage, and damage to public facilities was heavy.

AMERICAN RIVER BASIN

Floods of recordbreaking magnitude occurred December 22 and 23 in many streams in the American River basin as a result of heavy precipitation during the December 19–23 storm; the precipitation exceeded 20 inches over most of the basin (fig. 2). The peak discharge of 65,400 cfs December 23 in North Fork American River at North Fork Dam (site 368) was nearly 10 percent greater than the record flood of January 31, 1963. The flood hydrograph for North Fork American River at North Fork Dam is shown in figure 10. Initial storage in French Meadows Reservoir on the upper Middle Fork American River began just at the onset of the flood; the reservoir detained all the floodflow from the upstream area.

On the Rubicon River, tributary to Middle Fork American River, floodwaters accumulated behind the partly completed Hell Hole Dam to a depth of 150 feet and washed out part of the rockfill in the dam (fig. 14). The release in 1 hour of nearly 25,000 acre-feet of water December 23 created a flood wave that destroyed four bridges and four gaging stations and caused other high flood losses before it reached Folsom Lake where it was contained. A large number of logs and much debris were carried into Folsom Lake by the flood wave. Scott and Gravlee (1968) reported that the outflow reached a maximum 1-hour mean discharge of 258,000 cfs when the dam was breached, but the instantaneous peak discharge is indeterminate. The maximum stage on Rubicon River near Georgetown (site 377) about 10 miles downstream from the dam, was more than 45 feet higher than for the record flood of February 1, 1963. The peak discharge of Middle Fork American River near Foresthill (site 382), 36 miles downstream from Hell Hole Dam, was 310,000 cfs December 23, as compared to the previous maximum of 113,000 cfs. The flood surge was recorded at the Auburn gaging station on the Middle Fork American River (site 383) 55 miles downstream, and the peak discharge was still 253,000 cfs. The floodflows and particularly the failure of the Hell Hole Dam caused very extensive damage to various units under construction for the Placer County Water Agency's Middle Fork American River Project.

Other public-utility damage was also heavy, and a bridge on State

FIGURE 14.—Rubicon River flowing through breach in partly completed Hell Hole Dam, Calif., flood of December 22, 1964. Photograph, courtesy of McCreary-Koretsky Engineers, San Francisco.

Highway 49 was destroyed. Fortunately the flood wave traversed a steep, narrow, largely uninhabited canyon for most of the distance to Folsom Lake. Prompt warning by officers of the Placer County Sheriff's Office alerted downstream residents and prevented loss of lives. In the upper part of the South Fork American River basin, road damage from floodwaters and landslides was heavy. Storage in Union Valley and Ice House Reservoirs in the Silver Creek basin substantially reduced flood peaks in the river downstream from Silver Creek.

At Folsom Lake in the foothills, the inflow from the American River had peaked at 214,000 cfs and was receding before arrival of the Rubicon River flood wave. This peak discharge exceeded all peaks of record since 1904, and since at least 1850, it was exceeded only by the flood of January 1862. The surge from the Rubicon River raised the peak inflow to 280,000 cfs, which rivaled but probably did not exceed that during the flood of January 1862. The floodflows were fully contained in the reservoir, and outflow was controlled to the maximum design release of 115,000 cfs. Downstream from Folsom Dam the floodwaters were confined to leveed channels, and about 1,900 acres of land between levees was flooded. Minor flooding also occurred along Dry Creek, tributary to the lower part of the American River, and about 1,880 acres of agricultural and fringe-residential lands between Rio Linda and the Western Pacific Railroad tracks was inundated. Flood losses downstream from Folsom Lake included erosional damage to streambanks and levees, flooding of a trailer court and several commercial enterprises, and damage to public facilities by deposition of debris.

At the Sacramento weir (site 364), upstream from the city of Sacramento and the mouth of the American River, most of the Sacramento River flow, plus part of the large releases from Folsom Lake that flowed down the American River and upstream in the Sacramento River, were discharged to Yolo bypass (fig. 15). All the

FIGURE 15.—Floodwaters from Sacramento River flowing over Sacramento weir into Yolo bypass, near Sacramento, Calif., December 1964. Photograph, courtesy California Department of Water Resources.

weir gates were opened, and a peak discharge of 86,600 cfs was diverted December 25. Downstream in Sacramento the flow remaining in the Sacramento River (site 400) reached a maximum flow of 99,700 cfs December 25, slightly less than the 104,000 cfs recorded in November 1950. The suspended-sediment concentration reached a maximum of 2,200 ppm December 24, and the daily suspended load transported reached a maximum of 525,000 tons the same day.

Flows in Yolo bypass near Woodland (site 417) reached a peak of 265,000 cfs December 25, slightly under the record 272,000 cfs in

February 1942. The flow in the bypass is measured upstream from the Sacramento weir, but includes flows entering from Fremont weir upstream from Verona, Knights Landing Ridge Cut, and Cache Creek, a west-side tributary. The bypass flow near Woodland, combined with the flow from the Sacramento weir and west-side drainage in Willow Slough, produced a peak discharge of 370,000 cfs in Yolo bypass downstream near Lisbon, 9 miles southwest of Sacramento. The bypass has a design capacity of 490,000 cfs, and the flows December 25 were the largest since completion of the bypass system. All flows were confined within the bypass levees. The overflow of the weirs and resultant expected flooding within the bypass, including several tidal tracts, inundated a total of 92,400 acres of agricultural land used principally for growing high-income truck crops and rice, sugar beets, grains, and alfalfa. Flood damage was heavy. Agricultural damage included costs of repairs and rehabilitation of roads, farm equipment, and facilities and destruction of crops and loss of livestock by drowning. Public-facility damage included erosion of levees and roads and costs of flood fighting.

In the Cache Creek basin outstanding flood peaks occurred in streams tributary to Clear Lake, and peaks in Cache Creek and tributaries downstream from the lake approached previously established record flows. Heavy precipitation occurred in the headwater areas December 19–23, and again during the January 2–7 storm; the resulting flood peaks December 22 and January 5 were of comparable magnitude. In Adobe Creek near Kelseyville (site 401), the peak discharge of 1,500 cfs December 22 was only slightly more than the previous maximum flow of 1,450 cfs in January 1963, whereas in Scotts Creek near Lakeport (site 404) both the December and January peak flows were more than 25 percent greater than that in January 1963. In the North Fork Cache Creek near Lower Lake (site 410), the peak discharge of 19,700 cfs December 22 was only 3 percent less than the maximum flow of December 1937, and the peak discharge January 5 was the fifth highest for the 35-year period of record. Upstream from Clear Lake about 3,000 acres of agricultural land, principally orchards, was flooded. The heaviest flood losses occurred along Scotts Creek, where 2,500 acres was inundated, and included erosion, deposition of debris and sediment, and damage to county roads, farm roads, and equipment. Flood losses along Kelsey, Adobe, Middle, and Clover Creeks were similar, and a sand and gravel plant also was damaged.

Clear Lake was low at the onset of the flood; therefore the storage of about 325,000 acre-feet of water in the lake during the flood period was effective in reducing floodflows downstream. About 10,000 acres of land was flooded along Cache and Hungry Hollow Creeks downstream from Clear Lake. Flood damage included losses of crops, livestock, and pastures, as well as the costs of removal of debris and sediment, replacement of Stevens Bridge near Woodland, repairs to roads, bridges, and levees, and costs of flood fighting. Willow Slough and tributary sloughs, which drain the southern part of the Cache Creek basin and discharge into Yolo bypass, caused flooding of about 3,000 acres of land along the sloughs. Suspended-sediment concentrations in Cache Creek at Yolo (site 416) reached a maximum of 17,000 ppm January 5, and a maximum daily suspended-sediment load of 593,000 tons was transported January 6; during the December flood, the concentrations reached a high of 9,400 ppm December 23, and the daily suspended load was 365,000 tons.

Lake Berryessa, formed behind Monticello Dam on Putah Creek, retained virtually all the flow from the upper Putah Creek basin. Runoff was generally high in the upper basin. The peak discharge of 21,700 cfs December 22 in Putah Creek near Guenoc (site 420) was 68 percent of the maximum flow in December 1937. The peak bihourly inflow to Lake Berryessa (site 424) of 67,100 cfs December 22 was 83 percent of the maximum preproject peak discharge of 81,000 cfs in Putah Creek at Winters, at the site of Monticello Dam, that was recorded in 1940. Releases from Monticello Dam were controlled to 10 cfs until early January, when the reservoir spillway level was reached. The outflows, as measured at the gaging station downstream near Winters (site 425), reached a maximum of only 7,740 cfs January 7. The suspended-sediment concentration at the Putah Creek station near Guenoc (site 420) upstream from Lake Berryessa, reached a maximum of 3,400 ppm January 5, and the corresponding daily suspended-sediment load was 64,000 tons. The maximum daily suspended-sediment load of 67,000 tons was transported December 22 when the concentration reached a peak of only 2,450 ppm. A total of 1,900 acres of land was inundated in the upper basin, principally along Putah, St. Helena, and Dry Creeks, where the floodwaters remained on the land less than a day. Flood losses consisted of damage to private residences in the Mirabell Estates subdivision along St. Helena Creek, loss of stockpiles at sand and gravel plants, and costs of repairing farm roads and clearing debris and sediment from agricultural land. Downstream from Monticello Dam the outflows were within channel capacity, but some damages resulted from erosion along a county road and loss of campground facilities along Putah Creek.

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In the Sacramento-San Joaquin Delta, stormwinds and the heavy inflow of floodwaters caused unusually high water levels in the many sloughs and channels. One levee failed and about 400 acres of agricultural land east of the Bishop Tract was flooded. However, public-facility damage was heavy and consisted largely of the costs of flood fighting and repairs to levees and roads. Flows in the Sacramento River Deep Water Ship Channel were contained by the levees. The deposition of large quantities of sediment in the channel and in Suisun Bay necessitated extensive dredging to maintain navigation.

NORTH-COASTAL CALIFORNIA

The north-coastal region of California consists of those Pacific slope river basins extending from the Napa River basin on the south to the Klamath River and Smith River basins on the north. The major basins in the region are those of the Russian, Eel, and Klamath Rivers. Many smaller basins drain directly into the Pacific Ocean or into the San Francisco Bay. The location of the region in the flood area is shown in figure 1, and the location of sites 427-611 at which stage, streamflow, and sediment data are available, is shown in figure 16.

The floods of December 1964 were catastrophic in intensity and extent of damage over most of north-coastal California. Record or near-record stages and discharges occurred on most streams in the region from the Russian River northward. Flows in the Eel River and Klamath River basins far exceeded previous flows of record, but the floods were of lesser magnitude in some of the coastal streams between the Russian and Eel Rivers, in tributaries of the lower Russian River, and in streams tributary to San Francisco Bay.

A series of storms occurred during December and January in addition to the above-normal precipitation in November. Precipitation prior to December 19 raised soil moisture, produced moderate runoff, and created conditions highly favorable for flood runoff. The December 19–23 storm included very heavy rain December 21–23 that caused extremely high peak runoff and sediment concentrations and correspondingly high total runoff and sediment loads. Storms subsequent to December 23 maintained streamflow near flood stages for extended periods and caused recurrence of flooding in some areas. Heavy precipitation in early January caused significant floods again January 5 in streams in Marin County, in Russian River tributaries, and in coastal basins between the Russian and Eel Rivers that generally exceeded those in December.

Twenty-four lives were lost in north-coastal California, and flood damage was more than $195 million. The towns of Metropolitan and Pepperwood, in the Eel River basin, and Klamath, Klamath Glen, Camp Klamath, and Requa, in the Klamath River basin, were

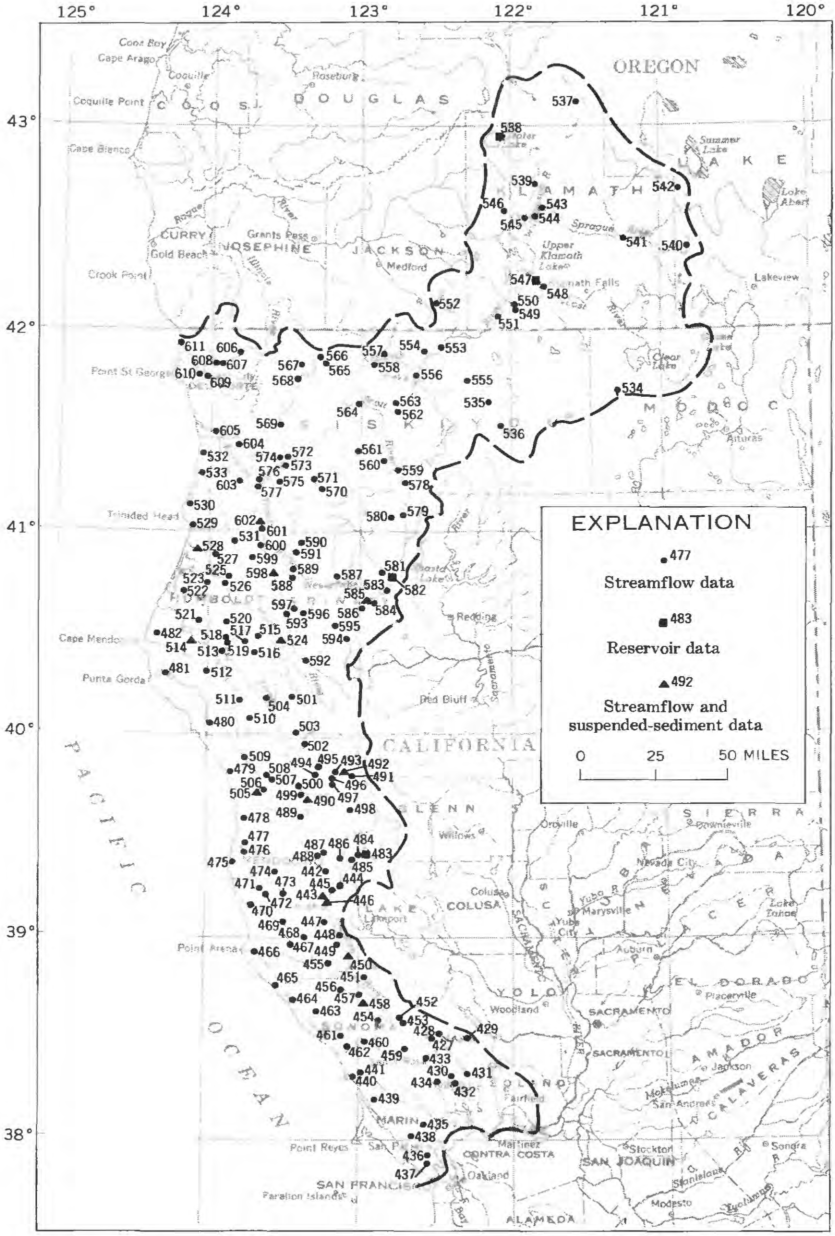

Figure 16.—Location of flood-data sites (427–611) in north-coastal California. Numbers refer to those in tables 19 and 20.

completely destroyed. Towns and communities that were severely damaged included Healdsburg and Guerneville in the Russian River basin; Myers Flat, Weott, Holmes, and Shively in the Eel River

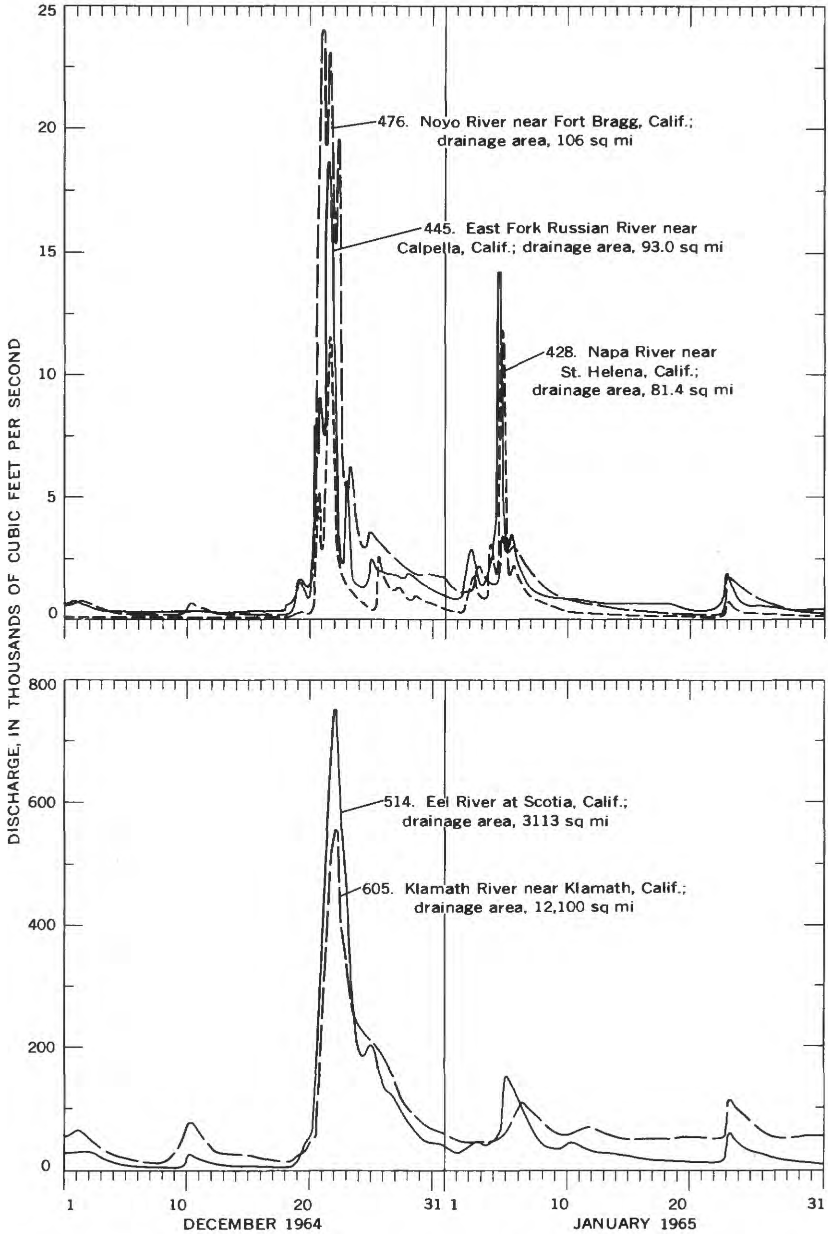

FIGURE 17.—Discharge hydrographs at selected gaging stations in north-coastal California, December 1, 1964–January 31, 1965.

basin; Orick in the Redwood Creek basin; Sawyers Bar, Orleans, Weitchpec, Hoopa, Willow Creek, and Hyampom in California, and Keno in Oregon in the Klamath River basin; and Gasquet in the Smith River basin. Many gaging stations were destroyed or damaged.

Suspended-sediment concentrations in north-coastal streams

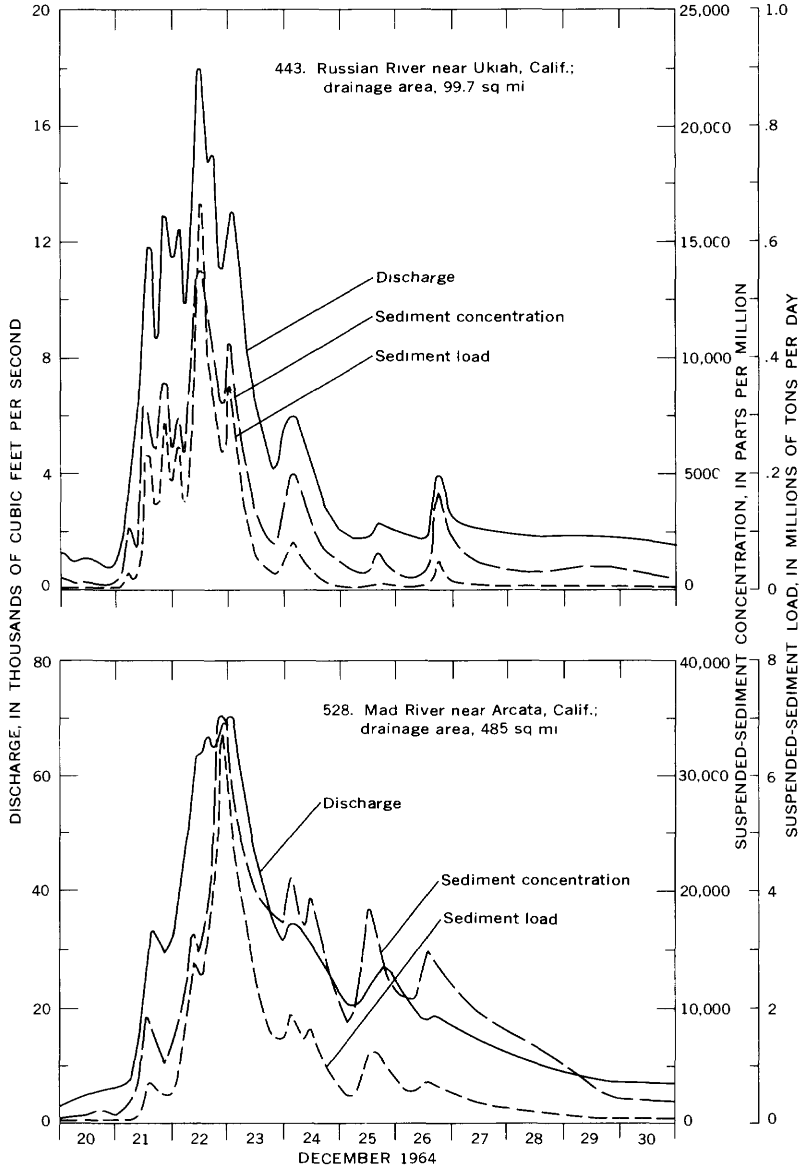

FIGURE 18.—Graphs of suspended-sediment concentration and load and stream discharge at selected stations in north-coastal California, December 20–30, 1964.

Eel River basin; Orick in the Redwood Creek basin; Sawyers Bar, reached maximums of 35,200 ppm in Mad River near Arcata (site 528) and 32,500 ppm in Trinity River near Hoopa (site 602). The suspended-sediment load of 57,000,000 tons transported by the Eel River at Scotia (site 514) December 23 was about 10 times the previous maximum daily load observed since 1957. Massive landslides, together with heavy bank erosion and channel scour, were the principal sources of sediment. Damage to roads, channels, and flood plains from sediment scour and deposition was severe along most streams in the region, especially in the Eel River and Klamath River basins.

The discharge hydrographs at selected stations in north-coastal California, shown in figure 17, illustrate the relative magnitude of floodflows during the period December 1–January 31. Graphs of suspended-sediment concentration and load and stream discharge at selected stations in the region for the period December 20–30 are shown in figure 18.

NAPA RIVER AND SONOMA CREEK BASINS

Major floodflows occurred in the Napa River and Sonoma Creek basins as a result of the December 19–23 and January 2–7 storms. At St. Helena the precipitation was 10.06 inches December 19–23; 9.14 inches occurred in the 72-hour period December 20–22, an occurrence similar to that in 1955; precipitation during the January 2–7 storm was 7.63 inches. The resulting floods in Napa River near St. Helena (site 428) reached peak discharges of 11,700 cfs December 22 and 11,800 cfs January 5; the December 1955 peak discharge was 12,600 cfs and that of January 1963 was 12,300 cfs. The discharge hydrograph for this station for December 1–January 31 is shown in figure 17. In other streams in the Napa River basin, the January 5 peaks were notably greater than those in December, but less than the previous maximums. Storage in Lake Hennessey on Conn Creek, tributary to Napa River, effected some reduction in the December floodflows downstream at Napa. However, January 5, the peak discharge of 14,300 cfs in Napa River near Napa (site 431) was 85 percent of the maximum flow in January 1963. Minor overflows and riverbank erosion occurred throughout the basin, but flood damage was light.

The principal flood peak in Sonoma Creek occurred in January. The peak discharge of 7,520 cfs January 5 in Sonoma Creek at Boyes Hot Springs (site 434) was 85 percent of the maximum flow in December 1955 and the second highest in the period of record since 1955. Precipitation in the basin was less than that in the Napa

River basin and the peak flow in December was not outstanding. Flooding and associated flood damage were relatively minor.

SMALL BASINS IN MARIN COUNTY

In Marin County streams, floods resulting from the storms of December and early January were generally moderate to high, and the principal peaks occurred January 5. Precipitation was heavy in the San Rafael–Kentfield area. At San Rafael the December 19–23 precipitation was 7.93 inches; at Kentfield it was 8.49 inches. The January 2–7 precipitation at San Rafael was 6.76 inches, and at Kentfield it was 7.45 inches. The peak discharge of 1,120 cfs January 5 in Novato Creek near Novato (site 435) was comparable to previous high flows and was 84 percent of the maximum flow of record. The flow in Corte Madera Creek was moderate, only about 39 percent of that in December 1955, but the streamflows and overflows of drains caused some local flooding in areas that are subject to frequent flooding, such as Kentfield, San Anselmo, and Corte Madera. Floodflows in the Walker Creek basin in the northwestern part of Marin County and in the nearby Salmon Creek basin in Sonoma County slightly exceeded previous maximums in 1958 in Walker Creek basin and in 1963 in the Salmon Creek basin. The Walker Creek flow was comparable to the December 1955 flow in North Fork Walker River near Tomales. Flood damages in the county were relatively light.

RUSSIAN RIVER BASIN

As a result of the December 19–23 heavy precipitation that exceeded 15 inches over much of the basin, peak discharges in the Russian River basin December 22–23 were generally higher than those that occurred in December 1955. Storm precipitation was 18.23 inches at The Geysers, near Geyserville, 19.01 inches at Kellogg, and 18.07 inches at Ukiah 4WSW, all in the upper part of the basin; 15.04 inches was observed at Cazadero in the lower part of the basin. A 24-hour total of 9.70 inches occurred at Kellogg. Heavy precipitation during the January 2–7 storm, as much as 12.44 inches at The Geysers, caused a recurrence of flooding, but peak discharges were generally lower than those in December. In the East Fork Russian River near Calpella (site 445), the peak discharge of 18,700 cfs December 22 was 41 percent greater than the previous maximum in December 1955; the peak of 14,400 cfs January 5 also was greater. Lake Mendocino, a flood-control and water-conservation reservoir completed in 1958 near the mouth of East Fork Russian River, fully contained the floodflows during the critical periods for both the December and January floods and reduced peak flows and damages along the middle and lower reaches of the Russian River. At the Hopland gaging station downstream (site 448), for example, a peak discharge of 41,500 cfs was recorded December 22, but the release from Lake Mendocino was only 10 cfs. Without the storage the peak flow at Hopland might have been about 57,000 cfs, on the basis of the 45,000 cfs recorded in December 1955. The peak stage in Russian River near Hopland December 22 was 26.01 feet, compared to 27.00 feet in 1955 and 30.0 feet in 1937. Without reservoir storage the 1964 peak stage might have exceeded 30.0 feet.

Flood runoff in streams tributary to the middle reach of the Russian River exceeded previous recorded maximums. As a result, despite the stage reduction attributable to storage in Lake Mendocino, floods of recordbreaking magnitude occurred on the Russian River near Healdsburg (site 454) and near Guerneville (site 460), where the peak discharges of 71,300 and 93,400 cfs December 23 exceeded previous maximum flows by 6 and 4 percent, respectively.

Suspended-sediment concentrations reached a maximum of 13,800 ppm December 22 in the Russian River near Ukiah (site 443), and the maximum suspended load transported was 352,000 tons the same day. However, concentrations in the East Fork Russian River near Ukiah (site 446), just downstream from Lake Mendocino, reached a maximum daily of only 1,900 ppm December 25, and the maximum suspended load transported was only 22,000 tons December 30. In the Russian River downstream near Cloverdale (site 450), suspended-sediment concentrations reached a maximum of only 6,900 ppm December 22, and the maximum daily suspended load transported was 495,000 tons the same day. During the January flood the concentrations reached a maximum of only 4,600 ppm January 5 in the Russian River near Ukiah (site 443) though the peak discharge was about 75 percent of that on December 22.

Flood damage in the basin exceeded that caused by the December 1955 flood. The greatest damage occurred in Guerneville and the surrounding resort area; 500 persons were left homeless, about 1,000 summer homes were damaged or destroyed, and several wood-products plants were damaged. The business district of Guerneville was flooded to depths of as much as 4 feet. One life was reported lost in the area. Heroic efforts in evacuation of personnel and removal of possessions prevented greater loss of life and reduced the flood losses. Highway transportation was disrupted completely during the floods as State highways and county roads were inundated throughout the basin; many roads were destroyed or severely damaged. Highway 16 from Hopland to Lakeport was closed by slides, and Highway 20 between Ukiah and Lakeport was closed by a bridge washout.

In the upper part of the basin, flood damage was limited largely to agricultural losses, though some residential losses were also incurred. About 25,000 acres of agricultural land in the Russian River valley was flooded. Damage to orchards, crops, and vineyards constituted the principal agricultural losses; however, some livestock was lost, and many farm buildings were damaged. Riverbank erosion caused the loss of many bank-protection works and many acres of highly developed cropland.

The discharge hydrograph for East Fork Russian River near Calpella for the period December 1–January 31 is shown in figure 17. Graphs of suspended-sediment concentration and load and stream discharge in Russian River near Ukiah for the period December 20–30 are shown in figure 18.

SMALL COASTAL BASINS BETWEEN RUSSIAN AND EEL RIVERS

During the December 19–23 storm, flooding occurred in all the small coastal basins between the Russian and Eel Rivers. The stages and flows were generally less than those during the recordbreaking floods of December 1955, except in Noyo River near Fort Bragg (site 476) where the peak discharge of 24,000 cfs December 22 was 2,000 cfs greater than that in 1955. The discharge hydrograph for this station is shown in figure 17. The storm precipitation was exceptionally heavy in the coastal area south of the Eel River, where 45.90 inches was observed at Ettersburg in the Mattole River basin; a 24-hour precipitation of 15.00 inches occurred December 21, and a 72-hour total of 30.90 inches occurred December 20–22. Precipitation in excess of 5 inches in 24 hours and 10 inches for the storm occurred at widely scattered locations, such as the Boonville Maintenance Station and Navarro in the Navarro River basin and Upper Mattole in the Mattole River basin. The peak discharge of 78,500 cfs December 22 in Mattole River near Petrolia (site 481) approached the record discharge of 90,400 cfs in 1955. Precipitation January 2–7 caused floods of lesser magnitude in basins midway between the Russian and Eel Rivers; in a few small basins the flows January 5 exceeded those in December.

Because this coastal area is very sparsely settled, the storm and flood losses consisted principally of damage to agricultural land, roads, bridges, and lumber mills. The main agricultural losses included sediment damage to pasturelands and loss of livestock. About 6,000 acres of land was inundated, principally in the Garcia River, Navarro River, and Mattole River basins. Damage to roads and bridges was heavy. The only appreciable loss of private property occurred in the Mattole River basin where lumber industry facilities were severely damaged and stocks of logs and finished lumber were lost. There was no loss of life in this area.

EEL RIVER BASIN

Unprecedented flood stages and peak discharges occurred December 22 in the Eel River basin in response to heavy precipitation of more than 23 inches over much of the basin during the December 19–23 storm. Precipitation was 10.7–12.4 inches in 24 hours at Branscomb, Cummings, and Laytonville in the South Fork Eel River basin and 22.7 inches in 48 hours was recorded at Laytonville. Along the main stem of the Eel River and its eastern tributaries, the peak stages and flows were much higher than those of the record peaks of 1955. At the gaging station on the Eel River below Dos Rios (site 500), the peak stage was 12.6 feet higher than the 1955 peak, and the discharge of 460,000 cfs was 63 percent greater than the record flow in 1955; at Alderpoint (site 504) the stage was 14.7 feet higher than that in 1955 and the peak discharge was 49 percent greater. Farther downstream at Scotia (site 514), the Eel River stage exceeded that of 1955 by 10.1 feet, and the peak discharge of 752,000 cfs was 39 percent greater than that in 1955. The 1955 peak stage on the Eel River at Scotia was comparable to that reached by the winter floods of 1861–62. The discharge hydrograph for the Scotia gaging station for December 1–January 31 is shown in figure 17.

Record flows occurred generally in the upper part of the Eel River basin where the peak discharges in the Eel River above Dos Rios and the Middle Fork Eel River above Black Butte River, near Covelo, were about 50 percent greater than those in 1955, the previous maximum flows. In the South Fork Eel River basin, the peak discharge of 199,000 cfs December 22 at the downstream gaging station near Miranda (site 511) was 15 percent greater than that in 1955; but in headwater areas the 1964 floodflows were less than those in 1955, despite the very heavy rain. Unprecedented maximum flows occurred also throughout the Van Duzen River basin, the principal tributary of the Eel River downstream from Scotia.

The December floods were the most extreme; they destroyed nine gaging stations and damaged almost all the remaining stations in the basin. The subsequent January 2–7 and 21–31 storms caused recurrence of minor flooding about January 5 and 24. Total runoff for the 2-month period December 1–January 31, expressed in depth of water in inches per unit area, exceeded 50 inches over much of the Eel River basin; as much as 67 inches was measured in South Fork Eel River near Branscomb (site 505), and 69 inches in South Fork Van Duzen River near Bridgeville (site 516). The extremely high runoff indicated that precipitation at the higher altitudes and in the extensive uninhabited areas and regions of difficult access in the Eel River basin was substantially greater than that reported at observation points.

Flood damage in the Eel River basin was catastrophic. The intensity of precipitation and the rate and magnitude of the runoff were much greater than forecast. The floods were of such magnitude that measures for evacuating cattle and other normal preventive activities provided only minor benefits. Commercial and residential development is concentrated along U.S. Highway 101, which parallels the South Fork Eel River and the Eel River main stem downstream from the South Fork. This part of the basin therefore suffered the greatest damage. The towns of Pepperwood, which had been rebuilt after the 1955 flood, and Myers Flat were obliterated. The communities of Weott, South Fork, Holmes (fig. 19,) Stafford, Shively, Scotia, Alton, and Phillipsville were very severely damaged. These

FIGURE 19.—Holmes, Calif., December 23, 1964, heavily damaged by flood in Eel River. Photograph by Eureka Newspapers, Inc.

communities and many others were completely isolated for a time. Rio Dell, on the lower Eel River, was cut off from all land routes, and all the city's telephone, electric-power, water-supply, and sewer facilities were out of service for several days. The high floodflows and floating debris flattened buildings or swept them off their foundations and destroyed bridges. Major highway bridges over the Eel River, such as the Stafford, Rio Dell-Scotia, and Paul Mudgett Memorial bridges (fig. 20) on U.S. Highway 101 and a bridge

FIGURE 20.—Paul Mudgett Memorial Bridge on U.S. Highway 101 over the Eel River at Rio Dell, 28 miles south of Eureka, Calif., destroyed by rampaging floodwaters, December 23, 1964. Photograph by Eureka Newspapers, Inc.

over the Van Duzen River on State Highway 36 were washed out. Highways 101 and 36 and many secondary roads also were severely damaged by slides and washouts and were closed for many weeks. The road closures hampered rescue efforts in the basin during the flood period and the subsequent rehabilitation work. State parks and national forests suffered extensive damage to roads, structures, and recreational facilities.

Damage to lumber mills and the lumber industry was devastating and constituted the principal industrial damage. A lumber company at Scotia lost 23 million board feet of lumber and 18 million board feet of prime redwood logs. The complete inundation of many lumber mills caused extensive damage to buildings and equipment. Tremendous quantities of logs, lumber, and debris carried oceanward accumulated in Humboldt Bay and along the beaches, and logs from the Eel River basin reportedly floated up the coast as far as the mouth of the Columbia River. Nineteen lives were lost in the Eel River basin area. Rescue operations by Armed Forces, National Guard, and Coast Guard and by State, county, and volunteer workers and, particularly, heroic emergency and supply operations by helicopter crews and pilots of small aircraft prevented greater loss of life. Helicopters were used extensively to carry supplies to isolated areas.

Agricultural damage in the Eel River Delta area was tremendous. Numerous farm homes and outbuildings were destroyed, damaged, or inundated, and about 4,000 head of cattle was lost. Valuable pasture lands and croplands were eroded and scoured or were covered with debris and sediment. About 60,700 acres of land in the basin was inundated. The dairy industry suffered serious damage to buildings and equipment, in addition to the loss of valuable breeding stock. The industry was hampered after the flood by lack of transportation facilities for dairy products. The Northwestern Pacific Railroad, which normally carries about 75 percent of the lumber shipped from the area, suffered severe damage from slides, washouts, and trestle losses. About 30 miles of track and roadbed was totally destroyed, and three major bridges were wrecked in the 100-mile reach along the Eel River from Rio Dell to Outlet Creek (fig. 21). Service on the railroad from San Francisco to Humboldt County was interrupted for 177 days. Communication lines and equipment were destroyed by slides and washouts throughout a large part of the basin.

Sediment transport and sediment damage in the basin were extremely heavy. Streambank erosion was severe, and many landslides occurred, especially in steep canyon reaches of the streams along

FIGURE 21.—Section of Northwestern Pacific Railroad track in Eel River canyon, California, undercut by flood of December 22, 1964. Photograph by Eureka Newspapers, Inc.

the highways and the Northwestern Pacific Railroad. Estimates of suspended-sediment concentrations, based on data obtained before the peak flows occurred, indicated that the maximum daily concentration at upstream gaging stations was about 9,000 ppm December 22 on the Middle Fork Eel River below Black Butte River, near Covelo (site 492). The maximum daily concentration downstream on the Eel River at Scotia (site 514), however, was about 32,000 ppm December 23, and the maximum daily suspended load at this station was estimated to be 57,000,000 tons, equivalent to 28 tons per acre, more than 10 times the previous maximum observed in 1960. Sediment data are not available for the 1955 flood. The suspended load transported at Scotia during the flood period December 19–27 was about 140,000,000 tons, equivalent to 84 tons per acre.

MAD RIVER BASIN

Flooding in the Mad River basin was severe as a result of heavy precipitation during the December 19–23 storm, but the operation of Ruth Reservoir in the headwaters helped to prevent recordbreaking peak discharges downstream. At the Mad River gaging station near Forest Glen (site 524), 9 miles downstream from the reservoir, the peak discharge of 20,100 cfs December 22 was 51 percent of the maximum flow of 39,200 cfs in December 1955, prior to construction of the reservoir. Extremely heavy runoff from downstream areas in the basin resulted in a peak discharge of 70,400 cfs December 23 in the Mad River near Arcata (site 528), 10 percent less than the record flow in December 1955. Suspended-sediment concentrations at the station near Arcata reached a maximum of 35,200 ppm about 4 hours before the peak discharge on December 22; a maximum daily sediment load of 3,140,000 tons occurred the same day. Graphs of suspended-sediment concentration and load and stream discharge for this station are shown in figure 18. Although the storms in January 1965 caused only minor flooding, the runoff December 1 to January 31 was 39 inches.

The flood inundated about 7,400 acres of land in the delta area and in agricultural areas in the Mad River valley. The agricultural land, about 6,400 acres of this total, was heavily damaged by erosion, scour, and deposition of sediment and debris. Dairy cattle losses were high despite efforts to evacuate them to higher ground. U.S. Highway 299 was damaged by slides and washouts, including the washout of the east-bank approach to the North Fork Mad River bridge. Lumber mills in the industrial area between the towns of Korbel and Blue Lake and the Pacific Ocean were damaged by the high flows, and logs from mill stockpiles were washed downstream and deposited in the delta area. The river was generally contained by the levee near Blue Lake. A break in the levee December 23, however, caused the flooding of several homes and evacuation of about 50 families.

REDWOOD CREEK BASIN

Orick, the only major community in the Redwood Creek basin, was completely inundated by the recordbreaking flood of December 22. The maximum flow of 50,500 cfs in Redwood Creek at Orick (site 533) was only 500 cfs greater than the peak flows of January 1953 and December 1955. However, the peak discharge at the Redwood Creek station upstream near Blue Lake was 36 percent greater than that in December 1955. The total runoff of 55 inches December 1–January 31 at Orick was about 10 percent more than that during a corresponding period in 1955–56.

The rapid rise in the creek at Orick December 22 forced evacuation of all residents. The rescue operations, made principally by boat, were completed without loss of life. The water reached a depth of 5 feet in the town, comparable to the depths in 1953 and 1955, and flooded nearly every home and business establishment. Most of the buildings were standing when the flood receded, but some were almost totally destroyed. About 1,400 acres of the 1,500 acres in the flood plain was flooded, and agricultural land was covered with logs, debris, and thick sediment deposits. Damage to communication facilities and agricultural land was the principal flood loss, and it accounted for more than half the total for the basin.

KLAMATH RIVER BASIN

In the Klamath River basin the flood runoff from the December 19–23 storm was of unprecedented magnitude. The peak discharge of 557,000 cfs in the early hours December 23 at the gaging station on Klamath River near Klamath (site 605) was 132,000 cfs greater than the maximum flow in December 1955 and probably was more than 100,000 cfs greater than the peak discharge in the winter flood of 1861–62. The storm precipitation was heavy throughout most of the basin, as shown in figure 2; the heaviest concentrations were in the rugged mountainous region in California that makeup the lower two-thirds of the basin.

Upstream from Upper Klamath Lake in Oregon the peak discharges of 14,900 cfs in Sprague River near Chiloquin (site 543) and 16,100 cfs in Williamson River below Sprague River, near Chiloquin (site 545), occurred December 26. This lag in timing of the peak flows is typical of the area. The flows were 224 and 210 percent of the previous maximum flows in April 1943, which were the highest records in 44 and 48 years. The peak flow in the Sprague River was 2.13 times that for a 50-year flood. The maximum daily inflow to Upper Klamath Lake was about 20,000 cfs December 25, but the corresponding outflow was only about a third of that and occurred in early January. The maximum discharge in the Klamath River at Keno, Oreg. (site 550), downstream from Upper Klamath Lake, however, was 8,480 cfs February 1, partly as a result of flood runoff from the January 21–31 storm. Necessary releases of water from Upper Klamath Lake in December exceeded the capacity of the Klamath River channel between Klamath Falls and Keno and caused extensive inundation of farmland and suburban areas at Klamath Falls.

A peak discharge of 29,400 cfs occurred December 22 in the Klamath River below Iron Gate Dam (site 553), near Hornbrook, Calif., upstream from the Shasta River. Downstream from Iron Gate Reservoir, in the lower two-thirds of the basin, virtually every gaging station, other than those on the middle reaches of the Trinity River main stem, had recordbreaking peak discharges in December. Eleven recording and five partial-record gaging stations were destroyed, and almost all the remaining gaging stations were damaged by the extreme floods. The towns of Seiad Valley, Happy Camp, Somesbar, and Orleans on the Klamath River main stem between Iron Gate Reservoir and the Trinity River, and Callahan, Etna, Greenview, and Fort Jones in Scott Valley were severely damaged by the floods. The spillway of Iron Gate Dam was severely eroded, and water rose almost to the ceiling in Iron Gate powerhouse, causing a lengthy shutdown for repairs.

In Shasta River near Yreka (site 556) the peak discharge of 21,500 cfs December 22 was more than 350 percent of that in December 1955, and the magnitude was 2.55 times that for a 50-year flood. The peak flows in other principal tributary streams, such as the Scott and Salmon Rivers and Indian Creek, were from 130 to 170 percent of previous record flows. At the Klamath River gaging station at Somesbar (site 574), the peak discharge of 307,000 cfs December 22 was 152 percent of that in 1955, the previous maximum in a 37-year record.

On the morning of December 22 a 2- to 3-million-cubic-yard landslide occurred in the Salmon River canyon about 6 miles upstream from the river mouth. The slide impounded water until it was breached at about 1700 hours. Water released by this temporary impoundment undoubtedly contributed to the record flow at the Somesbar gaging station, just downstream from the Salmon River. The floods destroyed all gaging stations in the Salmon River and Klamath River basins in the vicinity of Somesbar; thus, data are not available for detailed study of the impact of the landslide on streamflow.

Clair Engle Lake fully controlled the record-high flood runoff in Trinity River upstream from Lewiston, Calif. The bihourly inflow to the lake reached a maximum of 84,000 cfs December 22, 117 percent of the record flow at the gaging station at Lewiston (site 582) in 1955 before completion of the reservoir. The outflow was less than 263 cfs during the flood period. However, runoff from downstream tributary areas was also very heavy, as shown by the peak discharge of 95,400 cfs in South Fork Trinity River near Salyer (site 598). This peak flow was 146 percent of that in 1955. Thus, despite the reduction in runoff afforded by the storage in Clair Engle Lake, a record peak discharge of 231,000 cfs occurred December 22 at the gaging station downstream near Hoopa (site 602).

The coincidence of Klamath and Trinity floodflows, combined with the surge from the Salmon River and heavy local runoff, culminated in the tremendous peak discharge of 557,000 cfs in the

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Klamath River downstream at the station near Klamath (site 605). The towns of Klamath, Camp Klamath, Requa, and Klamath Glen on Klamath River were completely destroyed. Weitchpec, at the junction of the Klamath and Trinity Rivers, also was destroyed as floodwater rose to a stage 13.7 feet higher than that in 1861–62 and 19.5 feet higher than that in 1955. The towns of Willow Creek and Hoopa on the lower Trinity River were severely damaged. The

FIGURE 22.—Main Street, Klamath, Calif., after flood of December 23, 1964. Klamath River floodflows destroyed the town and damaged U.S. Highway 101 and the Douglas Memorial Bridge. Photograph by Eureka Newspapers, Inc.

discharge hydrograph for Klamath River near Klamath for the period December 1–January 31 is shown in figure 17.

Highway and bridge damage in the Klamath River basin was much greater than during any previous flood. The concrete-arch Douglas Memorial Bridge on U.S. Highway 101 over the Klamath River at Klamath (fig. 22) and a cable-suspension bridge on the river at Orleans on State Highway 96 were destroyed. Many other State and county bridges, including the one at Martins Ferry and those at Somesbar and Willow Creek on State Highway 96, were damaged or destroyed. Landslides and washouts were prevalent. State Highway 96 along the Klamath River main stem suffered considerable damage. Six miles of State Highway 299 along Willow Creek and parts of it along the Trinity River were damaged heavily. Owing to the extensive highway and bridge damages, many communities in the basin could not be reached by land routes during the flood period. Aerial relief and rescue operations were made by military agencies.

The principal agricultural damage occurred in the upper Klamath River basin near Keno and Klamath Falls, in Scott Valley, and at the mouth of the river. The damage included loss of livestock, as well as the loss of crop and pasturelands by scouring and sediment deposition. More than 102,000 acres of land was inundated; this land includes 43,300 acres in the Sprague River basin and 11,600 acres in the upper Klamath River basin in Oregon, and 26,500 acres in the Scott River basin in California. The lumber industry, the principal industry in the basin, was especially hard hit and suffered tremendous losses to equipment and property at lumber mills, including uncut logs and finished lumber. Electric power and telephone communication were cut off for considerable periods of time because of storm and flood damage to public and private utilities. The relatively sparse settlement of the Klamath River basin in California prevented much greater monetary damage than the $71.6 million reported by the Corps of Engineers. Damage to roads and bridges constituted 52 percent of the total. Four lives were lost in the area.

Landslides and streambank and channel erosion caused extensive changes in the morphology of the streams and produced large quantities of sediment. The extreme flows scoured the tributary stream channels and deposited sediment and debris in many of the main streams. As a result of the huge landslide in the Salmon River canyon, sediment concentration and load undoubtedly were high in the flow that discharged to the Klamath River. Suspended-sediment concentrations in the Trinity River near Hoopa (site 602) reached a maximum of 32,500 ppm December 22 about 3 hours before the peak discharge; the maximum daily sediment load of 8,900,000 tons occurred December 23. These figures are nearly 10 times greater than the maximums observed since 1956; sediment data are not available for the December 1955 flood. The heavy discharge of sediment from Campbell Creek, a lower Trinity River tributary near Hoopa, destroyed the measuring cable at the gaging station.

The January 2–7 and 21–31 storms produced moderate rises in most of the streams in the basin, but flood damage was not significant. However, in a few minor streams in the eastern part of the basin, the late January runoff exceeded that in December.

SMITH RIVER BASIN

Floodflows resulting from the December 19–23 storm far exceeded any previously recorded in the Smith River basin. Precipitation during the storm exceeded 20 inches over much of the basin (fig. 2) and was as much as 27.61 inches at Elk Valley and 27.05 inches at the Idlewild Highway Maintenance Station. A 24-hour precipitation total of 10.70 inches occurred December 22 at the Idlewild station. The peak discharge of 228,000 cfs December 22 at the gaging station on Smith River near Crescent City (site 610) was 138 percent of that in 1955, the previous maximum flow since 1931, and the magnitude was 1.9 times that of a flood having a recurrence interval of 50 years. The December 22 maximum flows of 41,100 cfs in the Middle Fork Smith River at Gasquet (site 608) and 162,000 cfs in South Fork Smith River near Crescent City (site 609) were correspondingly high, being 158 and 150 percent, respectively, of those in 1955. The December 1964 flood probably equaled or exceeded that of 1861.

The extreme floodflows destroyed the gaging station on Smith River near Crescent City. Floodwaters from the Smith River delta flowed through Talawa Slough to Lake Earl, north of Crescent City, and raised the lake level about 5 feet. About 9,300 acres of pastureland and agricultural land in the delta area and near Lake Earl was inundated. The resulting agricultural losses included damage to the land by scouring and by deposition of sediment and debris from lumbering operations. About 360 head of livestock, principally cattle, was lost.

Highways and bridges were heavily damaged by landslides and washouts caused by rain and high water. About 15 miles of U.S. Highway 199 in the Middle Fork Smith River canyon between Gasquet and Idlewild was severely damaged—1½ miles of the roadway and three bridges were completely destroyed. The Smith River bridge on U.S. Highway 101 also was severely damaged. Inundation and scouring destroyed about 98 miles of roadway surface, disrupting light-vehicle travel for many weeks and heavy-vehicle travel for nearly 2 months. Reconstruction of U.S. Highway 199 was slow because access to the highway was difficult and because a highway surface strong enough to withstand heavy loads was needed.

Tremendous quantities of sediment were produced by landslides, washouts, and extreme streambank erosion in the Smith River basin, as shown by the scoured appearance of the steep canyon walls and the eroded banks and channels of the main stem and tributary streams, as well as the extensive sediment deposits on the delta lands; however, specific sediment data are not available. A landslide west of Bear Basin Butte in the Six Rivers National Forest about 11 miles east of Gasquet destroyed more than 7 million board feet of virgin timber. The landslide was more than 2 miles long, and its maximum width was 700 feet. At the fork of Harrington Creek and the South Fork Smith River, 17 miles southeast of Gasquet, a 45-acre landslide destroyed about 1.6 million board feet of virgin timber.

Industrial losses consisted principally of the inundation of lumber mills and the attendant loss of logs and finished lumber, together with postflood shutdowns caused by shipping problems. The Crescent City water supply was cut off December 22 by flooding of the main pumping plant on the Smith River; service was not restored until January 4. In the interim water obtained from Tryon Creek had to be boiled for domestic use to avoid health hazards. There was no loss of life in the Smith River basin.

UPPER COLUMBIA RIVER AND SNAKE RIVER BASINS

The upper Columbia River and Snake River basins discussed in this report include that part of the upper Columbia River basin south of Spokane, Wash., and Pend Oreille Lake, Idaho, and that part of the Snake River basin downstream from Idaho Falls. The location of the region in the flood area is shown in figure 1, and the location of sites 626 to 847, for which stage, streamflow, and sediment data are available, is shown in figure 23.

Flooding was widespread over large areas of the Snake River basin and the Spokane River basin upstream from Spokane in late December and again in the western half of the Snake River basin in late January. Flood peaks were equal to or greater than those having recurrence intervals of 50 years or were the peaks of record on many streams in the basins of the Spokane, Portneuf, Owyhee, Boise, Malheur, Payette, Weiser, Grande Ronde, Clearwater, and Palouse Rivers during the December flood. In late January the

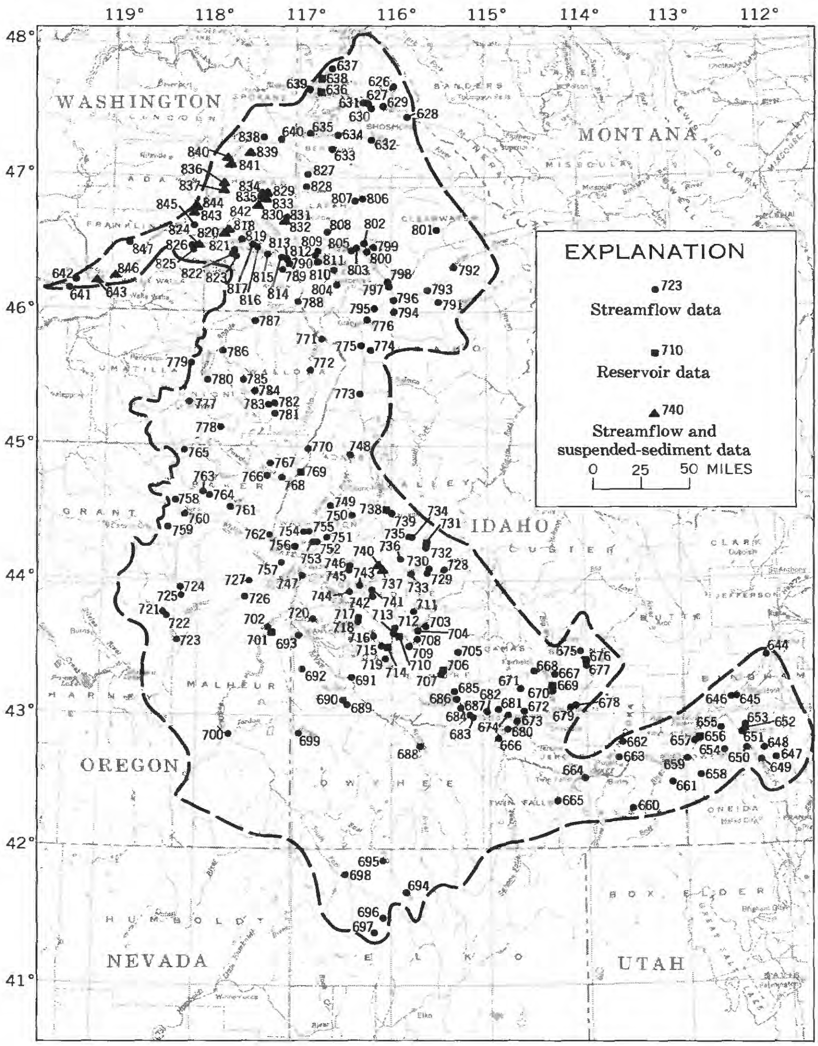

FIGURE 23.—Location of flood-data sites (626–847) in the upper Columbia River bia River and Snake River basins, December 16, 1964–February 15, 1965.

magnitudes of peak discharges on a few streams in the Grande Ronde River and Palouse River basins again equaled or exceeded those for a 50-year flood. Streams in the upper Columbia River basin generally transported relatively light sediment loads during both the December and January flood periods. Most streams in the Snake River basin, however, transported exceptionally heavy sediment loads during December, and a few streams in the lower Snake

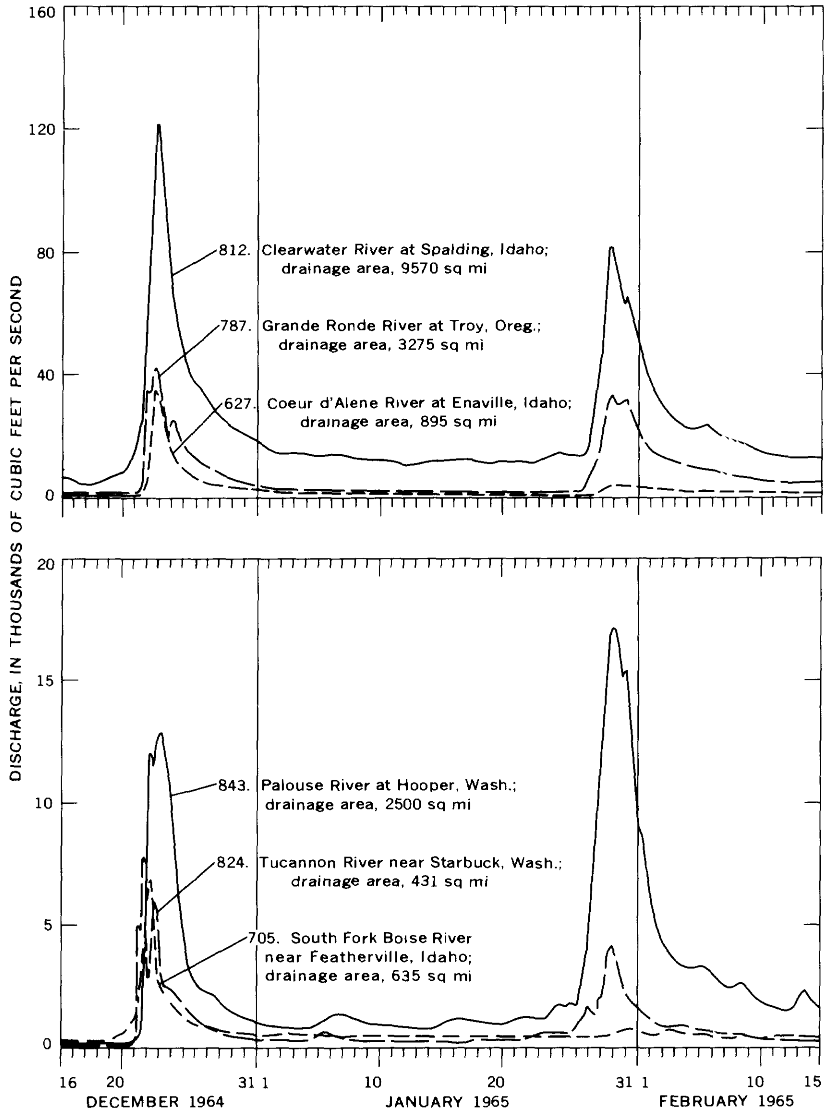

FIGURE 24.—Discharge hydrographs at selected gaging stations in the upper Columbia River and Snake River basins, December 16, 1964–February 15, 1965.

River basin transported greater sediment loads during January than in December.

Suspended-sediment concentrations were extremely high in several of the lower Snake River tributaries, as shown by the maximum concentrations of 360,000 ppm in Deadman Creek above Meadow

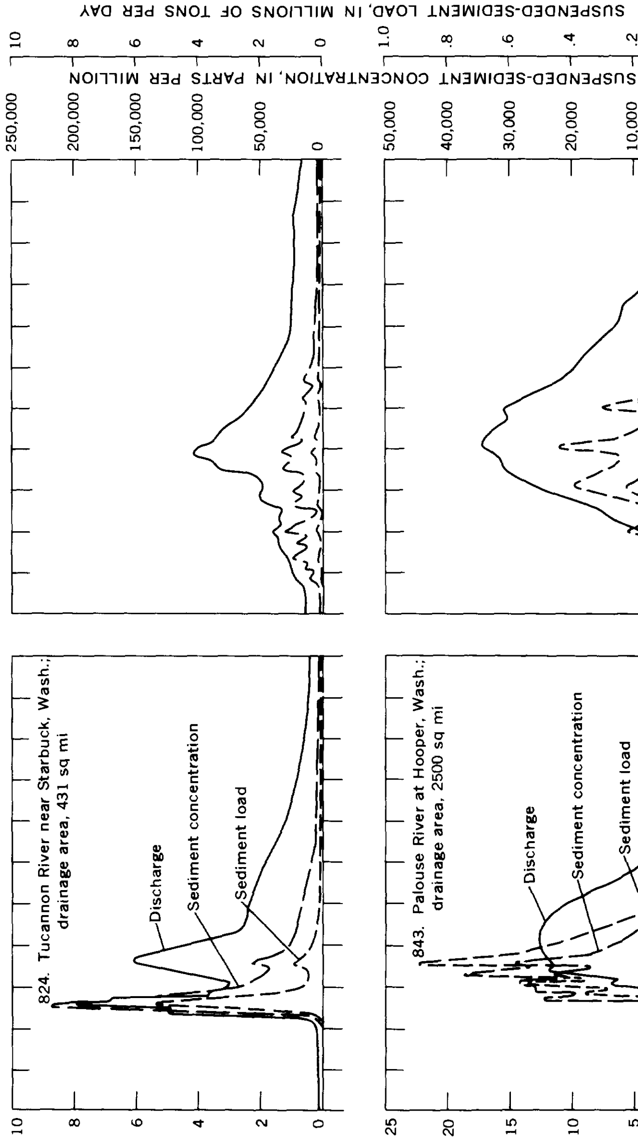

FIGURE 25.—Graphs of suspended-sediment concentration and load and stream discharge at selected gaging stations in the upper Columbia River and Snake River basins, December 20–30, 1964, and January 26–February 5, 1965.

Creek, at Central Ferry, Wash. (site 818) December 23, and 340,000 ppm in Meadow Creek near Central Ferry (site 820) and 223,000 ppm in Tucannon River near Starbuck (site 824) December 22. Sediment data for the region are available at only a few sites, primarily on the lower Snake River tributaries. Although the records are of short duration, they include data for the February 1963 flood.

Weather conditions prior to the floods were similar to those that caused severe floods in December 1955 in west-central Idaho and in December 1933 in the Coeur d'Alene River basin. The heavy rains during the December 19–23 storm (fig. 2), together with sudden snowmelt, produced outstanding floods. Frequent rains and snows during the early part of January kept the soils nearly saturated, and snow accumulations by late January in the basins of the upper Snake, Boise, Payette, and Salmon Rivers reached depths that were 150–190 percent of the 15-year average. Intense rains in late January combined with melting snow and again produced heavy runoff. Two lives were lost in Idaho in December, and the total losses from the two floods were more than $20 million.

Discharge hydrographs at selected gaging stations in the region, shown in figure 24, illustrate the distribution and relative magnitude of floodflows during the period December 16–February 15. Graphs of suspended-sediment concentration and load and stream discharge at selected stations for the periods December 20–30, 1964, and January 26–February 5, 1965, shown in figure 25, illustrate the relation between sediment transport and stream discharge for the principal flood periods.

UPPER COLUMBIA RIVER BASIN

Heavy runoff in the upper Columbia River basin occurred principally in tributaries of Coeur d'Alene Lake and minor flooding occurred on small tributaries of the Spokane and Yakima Rivers, as a result of the December 19–23 storm. Some minor flooding occurred in the lower Yakima River in late January. Reportedly large sediment loads were transported by the Coeur d'Alene River during December and by the Yakima River during January, but the sediment contribution from the upper Columbia River basin was small. The sediment load of the Columbia River at Pasco, Wash., for the 3-month period, December 1964–February 1965, was less than 2 percent of that for the Columbia River at Vancouver.

Precipitation during the December 19–23 storm was excessive for the region; at Wallace and Mullan, Idaho, totals of 5.02 and 6.04 inches were observed. During this same period the precipitation was 4.15 inches at St. Maries, 4.81 inches at Burke, and 3.13 inches at Coeur d'Alene. Streams rose rapidly December 22 in response to runoff from the heavy rains and rapidly melting snow. Peak flows were high, but generally did not exceed those of December 1933. The maximum stage of 77.15 feet December 23 in the Coeur d'Alene River at Enaville, Idaho (site 627), was 2 feet below that in 1933; downstream near Cataldo (site 631) the peak discharge of 47,200 cfs December 23 was only 70 percent of the maximum flow in 1933. The discharge hydrograph for the Coeur d'Alene River at Enaville is shown in figure 24.

The upper Spokane River basin upstream from Coeur d'Alene Lake received the full impact of the floods because there are no major flood-control reservoirs in that area. In Wallace, Idaho, 20 apartments of a veterans' housing area were washed into the South Fork Coeur d'Alene River. Downstream from Kellogg the rampaging Pine Creek washed out roads and bridges and isolated the community of Pinehurst for several days. Ice jams on St. Maries River caused flooding in the St. Joe River basin. The Corps of Engineers estimated flood losses in the upper Spokane River basin to be more than $2,700,000, of which nearly half consisted of damage to highways, roads, and railroads.

Natural storage in Coeur d'Alene Lake substantially modified the flood peak in the Spokane River downstream from the lake. Peak inflow to the lake in excess of 100,000 cfs December 23 was modified by storage, and the maximum outflow December 26 at the Spokane River gaging station near Post Falls, Idaho (site 639), was 30,900 cfs.

Tributary inflow in the Spokane, Wash., area generally was not unusually high in December, but the town of Tekoa, Wash., in the headwaters of Hangman Creek experienced the most severe flooding in the memory of longtime residents. The peak flow of Hangman Creek near the mouth, however, was not particularly outstanding, being equivalent to a flood having a recurrence interval of less than 10 years. Rock Creek breached dikes at the town of Rockford, Wash., and caused some local damage. Although local flooding was extensive, the peak stage of the Spokane River at Spokane December 26 was 0.6 foot below flood stage.

Rains in the upper Columbia River basin were generally lighter in January than in December, but 2 inches of rain in the lower Yakima River valley January 21–31 caused moderate flooding. Runoff was heaviest in the lower part of the basin where the Yakima River was above flood stage January 30–February 1.

The January flood in the Yakima River basin caused damages of about $480,000. The principal damage resulted from deposition of sediment on roads and inundation of pastureland and a few homes near Richland, Wash. Several thousand spring chinook salmon yearlings were flushed out of the rearing ponds at Niles Springs near Yakima; however, damage at this facility from erosion and deposition of sediment was minor.

SNAKE RIVER AND TRIBUTARIES UPSTREAM FROM TWIN FALLS, IDAHO

Major flooding in December in the upper Snake River basin was confined primarily to the Snake River valley downstream from the Portneuf River. The principal floods occurred December 23 in Bannock Creek and Rock Creek basins, which are near American Falls, and tributary to Snake River downstream from Pocatello. Though sediment data are not available for the area upstream from Twin Falls, the deposition on roads, farmland, and parks that was observed in the flooded low-lying areas indicates transport of large sediment loads during the floods.

Runoff from headwater areas of the Snake River basin was effectively controlled by Jackson Lake and by Palisades, Island Park, and American Falls Reservoirs. Storage in American Falls Reservoir reduced the peak inflow of about 15,000 cfs December 24 to a peak outflow of 5,990 cfs December 31, measured at the Snake River station at Neeley (site 657).

Floodflows in the Portneuf River were not exceptionally high. The peak discharge of 1,020 cfs December 23–26 in Portneuf River at Pocatello, Idaho (site 651), was only 34 percent of the maximum in a 55-year record. Bannock Creek flows washed out nearly all bridges in the lower part of the basin and flooded Interstate Highway 30N.

Flood damage in the Snake River basin upstream from Twin Falls totaled about $895,000. The losses included damages to bridges and county roads near American Falls Reservoir from flooding Snake River tributaries, damage to Register Rock State Park near American Falls from erosion and deposition of sediment, and damage from inundation of about 1,500 acres of low-lying land along the lower part of the Portneuf River. In the Burley–Twin Falls–Shoshone area, considerable damage was caused by local flooding of county roads, farms, and irrigation systems.

SNAKE RIVER BASIN BETWEEN TWIN FALLS AND WEISER, IDAHO

Recordbreaking floods occurred in parts of the basins of the Owyhee, Boise, Malheur, and Payette Rivers as a result of the December 19–23 storm, and many of the areas were flooded again in late January. The most erosive floods occurred in the Middle and North Fork Boise River basins and South Fork Payette River basin in December, and the major damage to agricultural, residential, and commercial property occurred in the lower Payette River basin. Flooding was not severe in the upper reaches of the Big Wood River, Bruneau River, and Owyhee River basins.

Precipitation typical of the mountain areas is indicated by that near Cascade Dam, at Cascade, northeast of Weiser, where 6.61 inches was observed December 19–23; 4.53 inches, December 24–January 20; and 2.74 inches, January 21–31. At Boise, in the valley area, precipitation was only 1.08 inches December 19–23 and 1.88 inches January 21–31.

In the Big Wood River basin, flows were excessively high only in the lower part of the basin. In the headwater areas Magic Reservoir on Big Wood River and Little Wood River Reservoir stored almost all inflow. At the gaging station on Little Wood River near Carey (site 677), only 3 miles downstream from Little Wood Reservoir, a moderate peak discharge of 2,400 cfs occurred December 23, as a result of heavy runoff downstream from the reservoir and failure of a small reservoir on Little Fish Creek. The floodflow, combined with runoff from small downstream tributaries, flooded roads and disrupted traffic. Downstream at the station on Big Wood River near Gooding (site 680), the heavy runoff produced a peak discharge of 8,860 cfs December 22, the highest flow in 48 years of record.

December flood losses in the Big Wood River basin were about $528,000. Debris plugged the intake structures and caused long shutdowns at two powerplants near the mouth of Big Wood River. About 4,200 acres of agricultural land was flooded in the Big Wood River basin, principally in the Shoshone and Gooding areas. Damage from high flows in late January consisted primarily of sediment deposition on roads and farmland following inundation of small areas by sidehill runoff.

Along the Snake River main stem, the December floodflow upstream from the Big Wood River was only equivalent to annual peak flows. Tributary inflow between Bliss and King Hill was exceptionally high. Clover Creek, with a drainage area of 265 square miles, had a peak discharge of 10,100 cfs at its mouth near King Hill (site 683) and partly washed out U.S. Highway 30 and a Union Pacific Railroad bridge (fig. 26). King Hill Creek overflowed U.S. Highway 30 and caused considerable damage and traffic delays. At King Hill (site 684) the recorded peak discharge of 31,900 cfs December 23 in the Snake River was equivalent only to a 10-year

FIGURE 26.—Damage to highway fill and railroad bridge over Clover Creek near King Hill, Idaho, December 23, 1964. Photograph, courtesy Idaho Department of Highways.

flood, but downstream near Murphy (site 691), the peak discharge December 24 increased to 38,300 cfs, equivalent to a 25-year flood.

Floodflows in the lower part of the Owyhee River basin in December were outstanding. In the middle of the Owyhee River basin near Rome, Oreg. (site 700), the peak discharge of 33,500 cfs December 24 was 120 percent of the previous maximum and 1.2 times the magnitude of the 50-year flood. Jordan Creek, an east-side tributary of the Owyhee River near Rome, had two peaks that far exceeded the previous peak of record in April 1952. The maximum flow of 7,530 cfs December 24 at the station near Jordan Valley (site 699) was more than twice the previous maximum and two times the magnitude of the 50-year flood. These high flows inundated parts of the town of Jordan Valley, Oreg., and some pastureland. More than 7,300 acres of agricultural land was inundated in the Owyhee River basin. December flood losses in the basin were about $327,000. Regulation by Owyhee Reservoir provided control of Owyhee River flows downstream and prevented major damage. Runoff from the late January storm was less than that in December, but the peak flow in Jordan Creek near Jordan Valley was the second highest for the period of record. However, flooding in the Jordan Creek valley was minor.

Floods in the mountainous areas of the Boise River basin in Idaho were extremely severe in December, but storage in reservoirs effectively prevented flooding in the lower reaches. The peak discharge of 18,800 cfs December 23 in Boise River near Twin Springs (site 704), just upstream from Arrowrock Reservoir, was nearly 170 percent of the previous record flow in May 1956 and 1.6 times the magnitude of the 50-year flood. In the South Fork Boise River near Featherville (site 705), the peak discharge of 6,810 cfs December 23 was only 90 percent of the record flow. The discharge hydrograph for this station is shown in figure 24. The three major reservoirs in the basin, Anderson Ranch, Arrowrock, and Lucky Peak, stored all inflow. Without this storage, an estimated peak discharge of 44,000 cfs would have occurred on Boise River at Boise (site 715), a flow greater than that of the great flood of 1896. Downstream from the reservoirs, Boise River flows were moderate, despite substantial local inflow, and at Notus the river remained below bankfull stage during the entire flood period. The December flood losses of $550,000 occurred mainly in the mountainous areas of the Boise River basin largely from erosion of forest land, road embankments, and bridge approaches and deposition of debris on roadways by water and landslides. The community of Atlanta on North Fork Boise River was isolated for several days, and about 60 residents of a lumber camp 20 miles below Atlanta on the Middle Fork Boise River were marooned by landslides and road washouts.

Heavy precipitation in late January near Boise produced high runoff in small tributary streams north of the city. Dry Creek, Crane Gulch, Stuart Gulch, and Cottonwood Creek spilled over their banks and caused local flooding in the Boise area. Deposits of sediment in the Cottonwood flume and on city streets was heavy. City of Boise officials (Columbia Basin Inter-Agency Committee, 1965, p. 80) estimated that the sediment yield of Cottonwood Creek (drainage area, 12 sq. mi.) was about 7 acre-feet per square mile, equivalent to 17 tons per acre. The January flood damage of about $100,000 occurred mostly in the Cottonwood Creek area.

Runoff was high in December in the Malheur River basin in Oregon, but reservoir storage was effective in preventing flooding in the lower part of the basin. Unregulated peak discharges in the Malheur River near Drewsey (site 722) and the North Fork Malheur River above Agency Valley Reservoir (site 724) exceeded previous maximums, and the magnitudes were 1.7 and 2.0 times the magnitude of 50-year floods. Warmsprings and Agency Valley Reservoirs contained the December floodflows and prevented severe damages in the cities of Vale and Ontario. Bully Creek, normally a heavy contributor to flooding in the lower part of the valley, reached a peak discharge at Warmsprings (site 727) that was twice the record flow in 1910, but was controlled by the recently completed Bully Creek Reservoir. The flood losses of $232,000 consisted primarily of damage to roads, bridges, and agricultural land upstream from the reservoirs and along tributary streams. Storage space was still available in the Warm Springs and Agency Valley Reservoirs for storage of the January floodflow; however, Bully Creek Reservoir was full, and spill over the dam contributed to flooding in the Malheur River downstream from Vale. January flood losses of $328,000 consisted principally of damage to farmland, roads, and bridges by erosion and sediment deposition.

Recordbreaking peak discharges were common in December in the Payette River basin in Idaho. Cascade and Deadwood Reservoirs stored upstream floodwaters and thus prevented greater peak flows in the lower part of the basin. Peak inflow to Cascade Reservoir December 22 was 12,700 cfs (computed by the Corps of Engineers), but outflow was controlled to 240 cfs. However, heavy runoff downstream from the reservoir resulted in a peak discharge of 6,700 cfs December 23 at the North Fork Payette River gaging station near Banks (site 740). This peak discharge was the highest since May 1947, yet a suspended-sediment sample obtained 6 hours after the peak showed a concentration of only 106 ppm. Deadwood Reservoir contained all inflow from the Deadwood River basin, but downstream near Banks the Payette River (site 737) December 23 reached a record discharge of 20,800 cfs, 151 percent of the previous maximum. Suspended-sediment observations in the Payette River near Banks indicated a concentration of 3,310 ppm December 23, about 5 hours after the flood peak; the concentration decreased to 1,420 ppm 23 hours later. Black Canyon dam downstream provided no significant control, and the flow in Payette River near Emmett (site 744) December 23 reached a record peak of 32,700 cfs, 140 percent of the previous maximum flow in 1938. A figure of 46,000 cfs for the natural peak discharge at Emmett (computed by the Corps of Engineers) indicated that flood storage effected a 13,000-cfs reduction in the peak discharge. At Payette the maximum flow in the Payette River December 24 was slightly less than that at Emmett owing to spill over levees and inundation of adjacent land, but the flow was still greater than the previous record flow in 1938. December flood damage in the Payette River basin was severe, and losses totaled about $721,000. The major damage resulted from erosion of road embankments and bridge approaches in the mountain areas and inundation of large areas of agricultural land in the lower valleys, with associated erosion of topsoil and deposition of sediment. Floodflows in late January were minor.

Floods in the Weiser River basin in Idaho generally were not as severe as those in the Boise River and Payette River basins. However, heavy damage occurred in the lower valley during December as ice jams in the Weiser River upstream from Cambridge caused overflow of the banks with consequent damage to buildings and roads. Peak flow in the Weiser River downstream at Weiser (site 753) was modified by storage in Crane Creek Reservoir; consequently, the natural peak of 20,000 cfs (computed by the Corps of Engineers) was reduced to an observed peak of 17,200 cfs December 23 and was 86 percent of that recorded in 1955. December floodflows in tributary streams in the lower part of the basin combined with backwater from the Weiser River and caused flooding of about 4,000 acres of agricultural land, and heavy losses of stacked hay and grain. December flood losses totaled $384,000. Runoff was light in January.

Few sediment data are available for streams in the Snake River basin between Twin Falls and Weiser. The evident severe erosion of river channels and road embankments, however, and the thick sediment deposits on roads and farmland indicated transport of exceptionally large sediment loads in December and somewhat smaller loads in January. Large sediment loads were transported by south-side tributaries of the Snake River between Twin Falls and the mouth of the Owyhee River. The Agricultural Research Service estimated, for example, that the combined sediment yield from the Reynolds Creek watershed near Murphy during the December and January floods averaged more than 1 acre-foot per square mile (Columbia Basin Inter-Agency Committee, 1965, p. 40). A suspended-sediment observation in Reynolds Creek January 28 indicated a concentration of 20,700 ppm.

Flood conditions near Weiser, Idaho, depend on the coincidence of discharges in the Weiser and Snake Rivers. The peak flow in Weiser River at Weiser occurred December 23, and that in the Snake River occurred December 25. The combined discharge of the rivers December 25 produced a peak stage of 12.62 feet—0.6 foot above flood stage—in the Snake River at Weiser (site 756). The corresponding discharge of 72,400 cfs was well below the peak of 84,500 cfs in 1952 and the record flow of 120,000 cfs in 1910.

SNAKE RIVER AND TRIBUTARIES BETWEEN WEISER AND LEWISTON, IDAHO

Floods resulting from the December 19–23 and January 21–31 storms in the Grande Ronde River basin in Oregon and the Clearwater River basin in Idaho were heavy and damaging; the floods in other basins along the Snake River between Weiser and Lewiston were moderate. The floods were of record magnitude at several sites in the Grande Ronde River basin during both storms. Flooding was generally minor on Burnt and Imnaha Rivers and streams that head in the Wallowa Mountains of Oregon. Damage in this part of the Snake River basin resulted principally from inundation of industrial facilities and from loss of buildings and logs, but considerable damage also occurred from erosion of road and railroad embankments. Flood damage was particularly severe along Lapwai Creek, east of Lewiston, Idaho. Highway repairs alone cost $875,000. Precipitation December 19–23 was 0.94 inch at La Grande and 1.61 inches at Baker, in Oregon, and 1.25 inches at Nez Perce and 2.75 inches at Orofino, in Idaho. During the January 21–31 storm, the precipitation at these stations was 5.18 inches, 1.55 inches, 2.20 inches, and 4.61 inches.

In the Powder River basin, flooding in December was restricted primarily to reaches downstream from Baker, Oreg. Peak flows were relatively low, but ice jams caused flooding of about 10,000 acres of agricultural land between Baker and North Powder. Thief Valley Reservoir, 18 miles north of Baker, the only storage reservoir in the basin, contained most of the upstream runoff of the Powder River and reduced flooding downstream.

Runoff in the Powder River basin in January was higher than that in December, but the peak flow of 1,150 cfs January 30 near Baker (site 764) was 63 percent of the record flow. About 22,000 acres of agricultural land between Baker and North Powder, pastureland adjacent to the Powder River downstream from Thief Valley Reservoir, and many roads were inundated. Flood losses were about $320,000 in December and $727,000 in January.

Floodflows in the Salmon River in Idaho were not exceptionally high during the flood periods, and damages were low owing to the limited development on the flood plains in the isolated, primitive areas. Peak discharge in the Salmon River near Whitebird in December was only about a fourth of the record flow.

December floodflows were relatively low in streams in the upper Grande Ronde River basin in Oregon, but record flows occurred in streams below La Grande. The peak discharge of 5,120 cfs December 24 in the Grande Ronde River at La Grande (site 777) was only

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58 percent of the previous maximum flow. Downstream at Troy (site 787), however, the maximum flow of 42,200 cfs December 23 was 141 percent of the previous record flow, and the magnitude was 1.1 times that for a 50-year flood. The discharge hydrograph for this station for the period December 16–February 15 is included in figure 24. Ice jams downstream from La Grande caused overflows and minor damage to grain and pasturelands and to levees.

In contrast, the January 21–31 storm produced a record-high runoff from the Blue Mountains northwest of La Grande, Oreg. At La Grande the Grande Ronde River January 30 reached a maximum flow of 14,100 cfs, nearly 160 percent of the previous maximum in 57 years of record, and 1.9 times the magnitude of a 50-year flood. Flows in downstream tributary streams were smaller than in December, and the peak flow January 29 in the Grande Ronde River at Troy was only 33,100 cfs, less than the December 23 maximum but still the second highest peak of record.

Flood damage in the Grande Ronde River basin was minor in December, but totaled more than $2.6 million in January. Upstream from La Grande, Interstate Highway 80N was extensively damaged. The Union Pacific Railroad was also heavily damaged and

FIGURE 27.—Spruce Street bridge on Grande Ronde River at La Grande, Oreg., destroyed by flood of January 30, 1965. Photograph, courtesy of U.S. Army Corps of Engineers.

was out of service for 5 days. Spruce Street bridge near La Grande was destroyed (fig. 27), and a railroad bridge at Island City collapsed. Inundation of about 300 acres of business and residential property in La Grande and 22,000 acres of agricultural land in the Grande Ronde River valley forced hundreds of people to evacuate their homes.

High flows in Asotin Creek, a west-side tributary of the Snake River between the Grande Ronde River and Lewiston, devastated much of the Asotin Creek valley in December. The peak discharge of 2,720 cfs December 23 at the gaging station near Asotin (site 789) was equivalent to a runoff of 16 cfs per sq mi, and the Corps of Engineers estimated a peak discharge of 6,500 cfs at the creek mouth. Two homes were swept away and numerous others were flooded, several bridges were washed out, and 800 acres of farmland was inundated by the sediment-laden floodwaters. Catastrophic erosion occurred on farmland and along stream channels. Flood damage was about $909,000.

Major flooding occurred in December along the Potlatch and North Fork Clearwater Rivers in the Clearwater River basin east of Moscow, Idaho. Runoff was relatively low upstream from the North Fork, although mud and rock slides along the Lochsa River isolated some areas for a short time. In the North Fork Clearwater River near Ahsahka (site 802) the peak discharge of 67,900 cfs December 23 was the second highest in 40 years of record, and 68 percent of the highest in 1933. Floodflows upstream at the gage at Bungalo Ranger Station and in the Potlatch River basin were comparable to those in May 1948, while the peak discharge of 122,000 cfs December 23 in Clearwater River at Spalding (site 812) was only 69 percent of that in 1948. The discharge hydrograph for this station on Clearwater River is included in figure 24. Most of the flood losses in the Clearwater River basin consisted of damage to roads and to the Potlatch Forests, Inc., plant at Lewiston, Idaho, including loss of logs. The flood damage was nearly $1.3 million.

In the Clearwater River basin, January floods were not as great on the large streams as those in December, but were very severe on the smaller tributaries at the lower altitudes and generally were more damaging than those in December. Flooding was particularly severe along Lapwai and Big Canyon Creeks, east of Lewiston, and the towns of Culdesac, Sweetwater, and Spalding were heavily damaged (fig. 28). The estimated total damage of $1.9 million in January in the Clearwater River basin included more than $1.3 million in the Lapwai Creek basin and nearly $400,000 in the Big Canyon Creek basin.

FIGURE 28.—Flooding on Lapwai Creek at Spalding, Idaho, January 30, 1965. Photograph, courtesy Lewiston, Idaho, Morning Tribune.

Along the Snake River main stem, flood storage in Brownlee Reservoir during December reduced Snake River peak discharge downstream by 6,000 cfs, but the flows were still great enough to cause $400,000 damage to the cofferdams at Hells Canyon damsite. Floodflows in January were smaller and caused little local damage. Downstream from the mouth of the Grande Ronde River, near Anatone, Wash. (site 788), the peak discharge in the Snake River increased to 121,000 cfs December 25 and was equivalent to floods having recurrence intervals of about 2 years.

SNAKE RIVER BASIN FROM LEWISTON, IDAHO, TO THE MOUTH

Very high streamflow and sediment loads were common in the Snake River basin downstream from Lewiston during the floods in December and in late January. Peak discharges were record high at several gaging stations, and sediment loads were at or near record magnitudes at every sampling station. Snowmelt runoff was not a major contributor to the floodflows. Snow depths in the area ranged from 0 to 26 inches just before heavy runoff began in late December, and at the lower altitudes where runoff was heavy the snow was only a few inches deep. Snow that had accumulated prior to the late January storm also contributed little to the overall runoff.

The Snake River near Clarkston, Wash. (site 814), crested December 24 at 247,000 cfs, well below the 300,000 cfs at which flooding normally begins, and the peak discharge January 30 was only 157,000 cfs.

Snake River tributaries between Clarkston and the Tucannon River, however, had high peak discharges and transported very heavy sediment loads. For example, Deadman and Meadow Creeks, near Central Ferry, Wash. (sites 818 and 820), had nonrecord peak discharges of 1,740 and 1,910 cfs December 22 and suspended-sediment concentrations of 360,000 and 340,000 ppm. The average sediment yield of these two basins December 22 was about 5 tons per acre.

In the Tucannon River basin, runoff in the upper reaches was low, and flooding on small tributaries at low altitudes was the main cause of damage in December. Runoff in downstream tributaries, such as Kellogg Creek at Starbuck, ranged from 100 to 170 cfs per sq mi. The peak discharge of 7,980 cfs December 22 in Tucannon River near Starbuck (site 824) exceeded the previous record flow of 6,000 cfs in 1930. Suspended-sediment concentration in Tucannon River near Starbuck reached a maximum of about 220,000 ppm December 22, and the daily suspended-sediment load was 1.6 million tons the same day, almost six times the previous maximum daily load of record observed in February 1963. Water containing approximately 20 percent sediment, by weight, flowed through the streets of Starbuck at depths of as much as 2 feet, damaged many homes, and left thick deposits of sediment on the streets. About 1,300 acres of agricultural land was flooded. A concrete bridge at Starbuck was washed out, and erosion damage to streambanks, road embankments, bridges, and farmland was very heavy. December flood losses in the Tucannon River basin were $636,000.

Runoff from the storm in late January was lower than that in December. The peak flow of 4,160 cfs January 29 in Tucannon River near Starbuck was only about half of that in December. The maximum daily suspended-sediment load of 192,000 tons was only an eighth of that in December, but was comparable to that in February 1963. Flows were generally contained in the main channel along most reaches of the river, but many roads, bridges, and about 320 acres of agricultural land were damaged by the floods. Damage totaled about $186,000.

December floodflows in the Palouse River basin were notably high, but the timing of the peak flows on tributary streams was not synchronized, and the relative magnitude of flows downstream on the main stem was not as high. At the station on Palouse River at Colfax (site 829), a record flow of 8,510 cfs occurred December 24, but the maximum suspended-sediment concentration of 15,300 ppm December 22 was relatively low for this site. Downstream at Hooper (site 843) the peak discharge of 12,800 cfs December 24 in the Palouse River was well below the 33,500 cfs recorded in February 1963. The total suspended-sediment load at Hooper during the December flood period was nearly as large as that during the February 1963 flood, but the maximum daily suspended load of 588,000 tons was only a fourth of the maximum daily suspended load in 1963. Losses were caused primarily by floods in the small tributary streams and included damage to buildings and a water-supply line in Elberton and erosion of autumn-seeded grainfields on steep slopes with resultant sediment deposition on roads and farmland. The December flood losses were about $472,000.

January flood runoff in the Palouse River basin produced flows that were generally higher than those in December. The January 30 peak discharge in the Palouse River at Colfax was slightly lower than that in December, but at Hooper the peak flow of 17,100 cfs January 30 was 34 percent greater, although it was only about half of the peak discharge in February 1963. The suspended-sediment load at Hooper was lower, though the sediment load transported during the January flood was comparable to those during earlier floods. Soil losses in some areas in the basin were reported to be as high as 50 tons per acre, most of which occurred during the January flood (Columbia Basin Inter-Agency Committee, 1965, p. 11–12).

As the crest of the December flood in the Snake River reached the Lower Monumental Dam project, about 36 miles northeast of Pasco, Wash., on December 24, a section of the cofferdam was washed out. The Corps of Engineers estimated that the peak discharge was 265,000 cfs, exceeding the cofferdam design flow of 200,000 cfs. Emergency repairs to the cofferdam permitted control of the lower floodflows in January. Damages to the Lower Monumental project were $1,040,000 in December and about $100,000 in January.

Downstream at Ice Harbor Dam on the Snake River, 10 miles upstream from the mouth, logs and debris accumulated in the forebay (fig. 29) and necessitated extensive cleanup after both the December and January floods. Sediment concentrations in the Snake River near Pasco were much greater than those in the Columbia River at Pasco. Observations during the flood period indicated that the suspended-sediment concentration in the Snake River down-

FIGURE 29.—Debris collected above Ice Harbor Dam on the Snake River after the December 1964 flood. Photograph by U.S. Army Corps of Engineers.

stream from Ice Harbor Dam (site 846) exceeded 4,300 ppm and was higher than those observed in February 1963.

The discharge hydrographs for Tucannon River near Starbuck and Palouse River at Hooper for the period December 16–February 15 are included in figure 24. Graphs of suspended-sediment concentration and load and stream discharge for these stations for the periods December 20–30 and January 26–February 5 are shown in figure 25.

LOWER COLUMBIA RIVER BASIN

The part of the lower Columbia River basin in the flood area, shown in figure 1, includes all tributary basins in Oregon downstream from the Snake River, and parts of tributary basins in Washington between the Yakima River and Bonneville Dam. Floods in the Willamette River basin are described separately. The location of sites 848 to 1008, for which stage, streamflow, and some sediment-transport data are available, is shown in figure 30.

Floodflows were outstanding in December 1964 in the lower Columbia River basin and were exceptionally high again in late January in tributaries immediately downstream from the Snake River. Daily

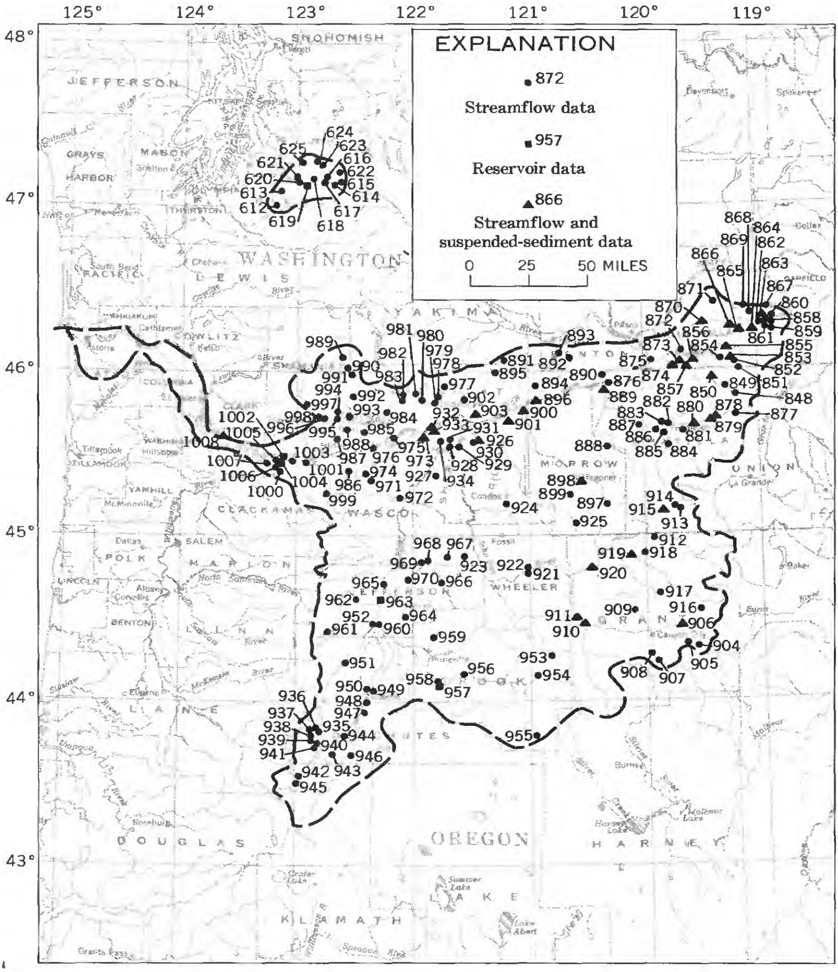

FIGURE 30.—Location of flood-data sites (848–1008) in the lower Columbia River basin and the minor area of flooding in Washington (612–625). Numbers refer to those in tables 19 and 20.

discharge in the Columbia River at The Dalles (site 975) reached 364,000 cfs December 25, the highest winter discharge since December 25, 1933; that of 314,000 cfs January 31 was the second highest. At Vancouver, Wash., upstream from the confluence with the Willamette River, the daily discharge reached a maximum of 500,000 cfs December 25, the suspended-sediment concentration was nearly 4,000 ppm, and the daily sediment load transported was 3.5 million tons. An extremely high suspended-sediment concentration of 350,000 ppm was reached December 22 in Dry Creek at Lowden, Wash. (site 856), a tributary of the Walla Walla River.

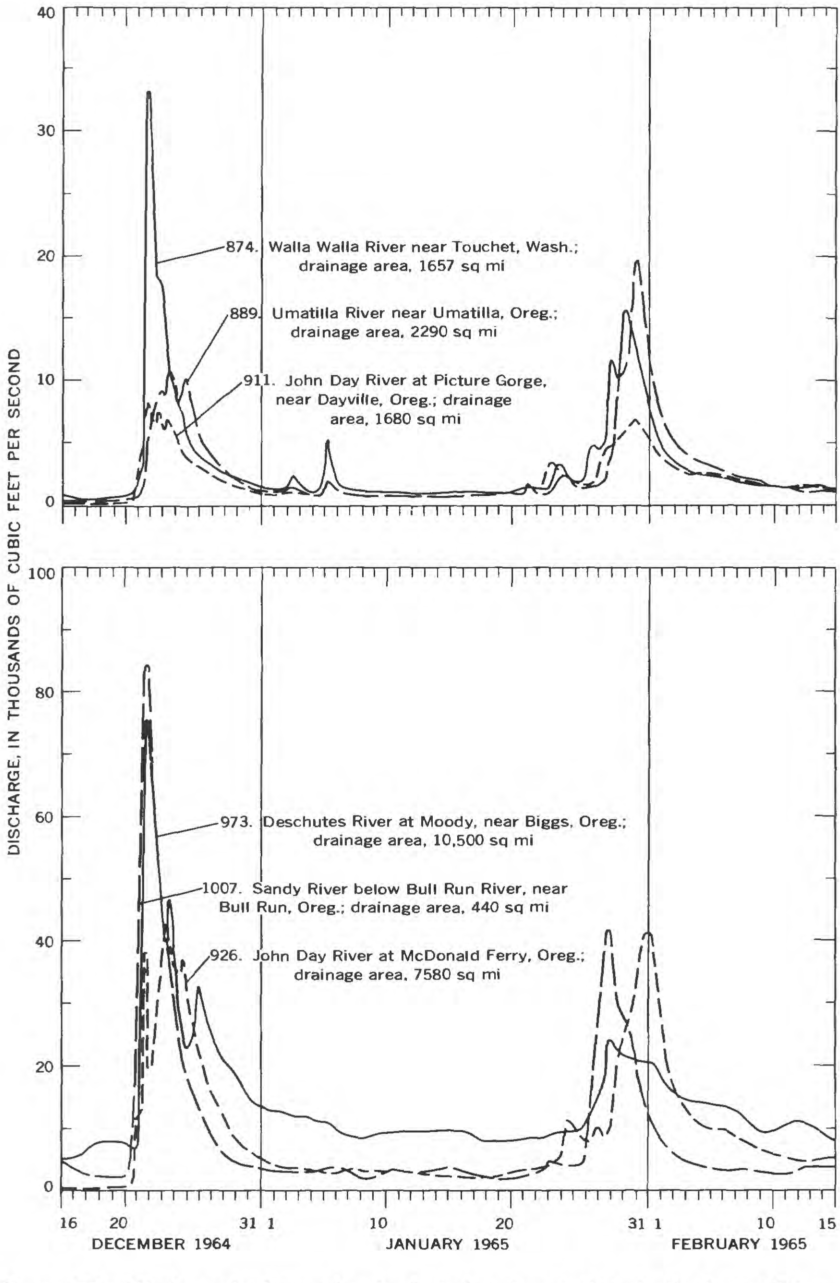

FIGURE 31.—Discharge hydrographs at selected gaging stations in the lower Columbia River basin, December 16, 1964–February 15, 1965.

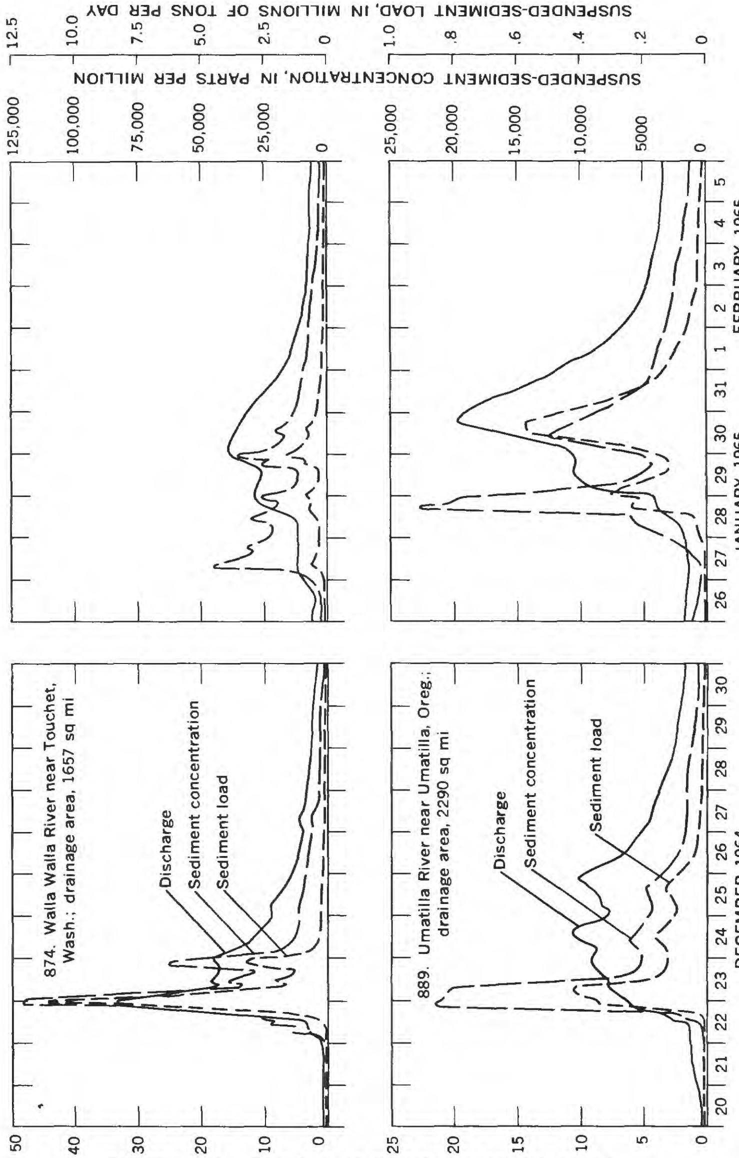

FIGURE 32.—Graphs of suspended-sediment concentration and load and stream discharge at selected gaging stations in upper tributaries of the lower Columbia River basin, December 20–30, 1964, and January 26–February 5, 1965.

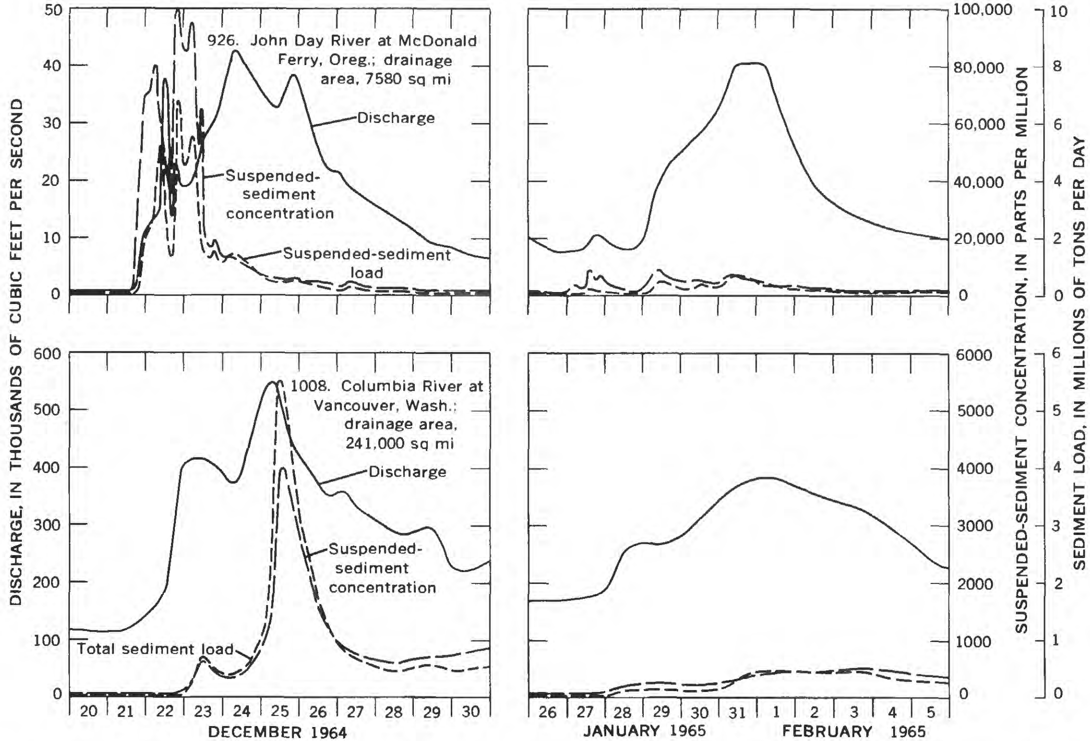

FIGURE 33.—Graphs of suspended-sediment concentration and load and stream discharge at selected gaging stations in the lower Columbia River basin, December 20–30, 1964, and January 26–February 5, 1965.

Severe flooding on tributary streams contributed to the high flows in the lower Columbia River. The record peak discharges on many of the streams in late December were the result of runoff from heavy rains falling on snow and frozen ground and from snowmelt. Heavy sediment loads occurred when the frozen ground prevented infiltration and yet provided little protection to the surficial soils. Floods produced by steady rains in January were even greater than those in December in the upper Walla Walla River, Umatilla River, and North Fork John Day River basins. However, flooding in January was minor in basins downstream from the John Day River.

The December floods in the Oregon part of the region took 12 lives and caused more than $34 million damage, of which nearly half was to agriculture and transportation. Discharge hydrographs at selected gaging stations in the lower Columbia River basin for the period December 16–February 15, shown in figure 31, demonstrate the relative magnitude of flows during the two principal floods. Graphs of suspended-sediment concentration, sediment load, and stream discharge for the periods December 20–30, 1964, and January 26–February 5, 1965, at gaging stations on two upstream tributaries of the Columbia River in the region are shown in figure 32, and graphs for a midregion tributary and the lower main stem are shown in figure 33.

WALLA WALLA RIVER BASIN

Serious flooding occurred throughout the entire Walla Walla River basin in December and again in January. Precipitation at Walla Walla, Wash. (alt. 900 ft.), was only 1.46 inches December 19–23 and 2.26 inches January 21–31, but at a station only a few miles to the east (alt. 2,400 ft), 4.50 and 8.79 inches of precipitation were reported during the same periods (figs. 2 and 4).

In Touchet River and Mill Creek, runoff from warm rains and snowmelt produced outstanding flood peaks in December. The peak discharge of 9,350 cfs December 23 in Touchet River at Bolles, Wash. (site 866), was more than double the previous maximum flow and 1.3 times that for a 50-year flood; the 5,450 cfs December 23 in East Fork Touchet River near Dayton (site 858) was the maximum of record and 1.5 times that for a 50-year flood. Flooding in the Touchet River basin from Dayton to Waitsburg was the most serious in the Walla Walla River basin. Sewer systems were flooded in both Dayton and Waitsburg. Most of Waitsburg was flooded when levees were topped or breached, and several homes were washed away. Many farms and roads were flooded and damaged severely by erosion or by deposition of sediment. Downstream, at Touchet, the Touchet

River (site 873) transported a suspended-sediment load of almost 2.3 million tons December 22–25.

In Mill Creek near Walla Walla (site 851), the December 23 peak discharge of 3,240 cfs was 124 percent of the previous maximum flow and was equivalent to a 35-year flood. The peak flow at the creek mouth was reduced substantially by diversion of part of the flow into a flood-control reservoir. Flooding and erosion caused severe damage to farmland and recreational areas. Just downstream from Blue Creek the suspended-sediment load transported by Mill Creek (site 853) December 22–24 was 89,200 tons, about five times the load for the highest 3-day period since October 1962.

Floodflows in Pine and Lower Dry Creeks caused considerable damage. Erosion was extremely severe in lower Dry Creek basin, especially on agricultural land. Outstanding sediment yields in Dry Creek basin were indicated by the maximum suspended-sediment concentration of about 350,000 ppm (35 percent of the discharge by weight) and the maximum daily suspended-sediment load of 1.6 million tons December 22 that were determined at Lowden (site 856).

The December floods in the upper Walla Walla River basin were not outstanding. In the lower basin, however, the floodflows were of record magnitude, the peak discharge of 33,400 cfs December 22 in Walla Walla River near Touchet (site 874) was more than twice the previous maximum and 1.9 times the magnitude of the 50-year flood. Suspended-sediment concentration reached 120,000 ppm December 22, and the suspended-sediment load December 22–25 was an outstanding 6 million tons. The discharge hydrograph for Walla Walla River near Touchet for the period December 16–February 15 is included in figure 31, and the graphs of suspended-sediment concentration and load and stream discharge for the periods December 20–30 and January 26–February 5 are shown in figure 32. The town of Milton-Freewater, Oreg., 11 miles south of Walla Walla, Wash., suffered some flood damage caused principally by local runoff. Total damage in the Walla Walla River basin from the December flood was nearly $2.8 million.

The late January floods in the Walla Walla River basin were concentrated in the upper part of the basin. Floodflows January 29 and 30 in the North and South Forks of the Walla Walla River near Milton (sites 848 and 849) slightly exceeded previous maximums, and the magnitudes were equivalent to floods having 23-year and 35-year recurrence intervals. Damage to roads, bridges, and culverts was heavy along the South Fork, and some farmland was inundated along the North Fork Walla Walla River. In Mill Creek near Walla Walla (site 851) in the lower part of the basin, the maximum flow of 3,680 cfs January 29 was greater than the peak flow in December and was equivalent to a 50-year flood. The daily sediment load in Mill Creek downstream from Blue Creek, however, was only about two-thirds of that in December. Along the Touchet and lower Walla Walla Rivers the January peak flows were less than those in December, although severe levee damage occurred along the Walla Walla River near Milton-Freewater (fig. 34). Damage of $671,000 in the Walla Walla River basin resulted from the January floods.

FIGURE 34.—Levee damage on the Walla Walla River near Milton-Freewater, Oreg., caused by flood of January 30, 1965. Photograph by U.S. Army Corps of Engineers.

UMATILLA RIVER BASIN

Floods resulting from the December 19–23 storm in the Umatilla River basin in Oregon were moderate, but those in late January were outstanding. Peak discharges in January were record high on many streams throughout the basin and exceeded the 50-year flood at many sites. Runoff from rain falling on snow and on frozen ground produced the floods.

Weather records at Meacham (alt 4,050 ft) indicate that 3.20 inches of precipitation occurred December 21–24, and the total snow depth of 16 inches melted completely when the temperature stayed above 32°F for 1 day; 4.00 inches of precipitation occurred January

27–30, and the snow depth dwindled from 24 to 7 inches when the temperature remained above 32°F for 3 days.

The principal streams generally contained the high runoff within the channels in December, but overflows along small tributaries caused considerable damage. Flooding at Athena and Adams, northeast of Pendleton, Oreg., was caused primarily by debris choking the channels. Water from high flows in Stage Gulch was 4 feet deep in the streets of Stanfield, west of Pendleton, and many people were evacuated from the town. Roads, railroads, and bridges throughout the entire basin suffered severe damage, largely from erosion of embankments and bridge approaches and deposition of sediment and debris on roads. The sediment load transported by the Umatilla River near Umatilla during December was small in relation to those in Walla Walla and John Day Rivers, although it was greater than any since October 1962. The December floods caused losses of $828,000 in the Umatilla River basin. The Union Pacific Railroad Co. reported an additional $848,000 damage caused by sidehill runoff and losses of $200,000 from interruptions in railroad service throughout the basin.

Flooding in late January was extensive along the main stem of the Umatilla River and on many of the tributaries. The river did not overtop the levees in Pendleton, but agricultural land upstream and the settlements of Cayuse and Thornhollow were flooded and roads were further damaged. The peak discharge of 15,500 cfs January 30 in Umatilla River at Pendleton (site 882) just surpassed the maximum of record, which occurred in 1949, but was less than the flow of about 17,000 cfs in 1882. McKay Creek Reservoir South of Pendleton held the heavy runoff from upper McKay Creek until after the peak had passed on the Umatilla River, and the resulting peak discharge of 15,900 cfs January 30 downstream in Umatilla River at Yoakum (site 887) was only 79 percent of the record flow of 1906. Runoff in the lower part of the basin was heavy and caused severe flooding in the town of Echo (fig. 35). The heavy runoff increased Umatilla River flow downstream, and the peak discharge at the station near Umatilla (site 889) was slightly greater than the maximum in 62 years of record, and 1.3 times the magnitude of the 50-year flood. A suspended-sediment load of 1.1 million tons was transported January 28–February 3, a load 2–5 times greater than that during flood periods in December 1964 and February 1963. Flooding recurred at Athena and Adams, and more than 12,000 acres of agricultural land was damaged by inundation and erosion. The January floods caused losses of more than $1,8 million.

The discharge hydrograph for Umatilla River near Umatilla for

FIGURE 35.—Flooding Umatilla River at Echo, Oreg., January 30, 1965. Photograph by U.S. Army Corps of Engineers.

the period December 16–February 15 is included in figure 31, and the graphs of suspended-sediment concentration and load and stream discharge for the periods December 20–30 and January 26–February 5, are shown in figure 32.

WILLOW CREEK BASIN

Flooding in the Willow Creek basin of Oregon in December occurred principally in the lower reaches of the valley. In the upper part of the basin, runoff was relatively light as very little snow was on the ground when the warm rains came. At Heppner (site 898) the peak discharge of 464 cfs December 24 was only 57 percent of the maximum of record, and the sediment load was relatively light. Eightmile Canyon, a Willow Creek tributary about 7 miles upstream from the mouth, was a raging torrent and was the major contributor to flooding of the lower part of the Willow Creek valley. The Willow Creek gaging station near Arlington (site 900) was demolished by the debris- and sediment-laden floodwaters. The peak discharge of 14,700 cfs December 22 (computed by field survey at the site) was seven times the previous highest discharge recorded in a 5-year record. Damage to roads, bridges, and railroads was heavy, and flood losses were about $1.2 million. Gullying and sheet erosion of farmland, combined with bank sloughing and channel scour, resulted in enormous quantities of sediment being transported downstream. The suspended-sediment load December 22–24 was about 1.1 million tons, nearly seven times that for February 2–6, 1963, which was the highest since October 1962.

In late January, Willow Creek was again above flood stage, but the principal runoff occurred in the upper Willow Creek basin. The peak flow of 635 cfs January 30 at Heppner (site 898) exceeded that in December, but was less than the peak of record in 1957 and only a fraction of the June 1903 disastrous cloudburst flood peak of 36,000 cfs, which took more than 200 lives. Agricultural land in the lower valley was inundated again.

JOHN DAY RIVER BASIN

Floods of record magnitude occurred in December or in January in most of the major streams in the John Day River basin in Oregon. Strawberry Creek near Prairie City (alt 4,909 ft) and Camas Creek near Lehman (alt 3,969 ft) were the only regularly gaged streams that did not have record peaks.

December floodflows were extremely high along the main stem of the John Day River from Prairie City to the mouth. Peak discharges in John Day River at Prairie City (site 906) and at Picture Gorge (site 911), downstream from South Fork John Day River, were 114 and 120 percent of previous record flows and about 1.4 times the magnitude of the 50-year floods. The towns of Prairie City, John Day, Canyon City, Mount Vernon, and Dayville were flooded. About 70 percent of the upper John Day River valley was inundated; extensive damage to agricultural lands occurred from erosion and sediment deposition (fig. 36). Floodflows in the South Fork John Day River devastated much of the valley upstream from Dayville and destroyed two county-road bridges. More than 14,000 acres of land was flooded. On the Middle Fork John Day River, the December peak discharge at Ritter was moderate, but downstream, in North Fork John Day River at Monument (site 920), the peak discharge of 31,100 cfs December 22 far exceeded the 22,000 cfs peak of March 1932, which was the maximum since at least 1925 and was 1.6 times the 50-year flood.

At the John Day River gaging station at McDonald Ferry (site 926) the peak discharge of 42,800 cfs December 24 exceeded the historic peak of 1894 and was more than 1.5 times the 50-year flood. Heavy runoff principally from Rock Creek and other local tributaries caused a sharp increase in discharge at the McDonald Ferry gage on the afternoon of December 21. The discharge of the

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FIGURE 36.—Typical field erosion in upper John Day River valley after flood of December 23, 1964. Photograph, courtesy Grant County Extension Agent.

first of two peaks was 37,900 cfs at noon December 22. The suspended-sediment concentration at that time reached 100,000 ppm. After a recession to 13,600 cfs the afternoon of December 22, the discharge increased again and reached the record peak December 24. The second peak was the result of runoff from upstream tributaries. The discharge remained above 30,000 cfs from 1900 hours December 23 to about 0700 hours December 26. The sediment concentration was reduced rapidly by the relatively dilute water. A suspended-sediment load of more than 9 million tons passed the McDonald Ferry station December 21–26.

Extremely high peak discharges in Grass Valley Creek—tributary to the John Day River downstream from McDonald Ferry—and other tributaries in the lower river combined with main stem flows and produced an early peak of very high magnitude at the mouth of the river. During the initial part of the rise, two spans of the new bridge on Interstate Highway 80N near Rufus, Oreg., collapsed into the river. The spans remaining after the disaster are shown in figure 37. One person was killed when the bridge collapsed, and two were killed when they drove through a barricade at the bridge approach. Losses resulting from the December floods were extraordinarily high in the John Day River basin, totaling nearly $5 million.

Runoff from the storms in late January caused a recurrence of flooding in many areas along the upper main stem of the John Day River that also had been flooded in December. At Prairie City (site 906) the peak discharge of 1,840 cfs January 30 was less than that in December and the prior maximum flow, but still slightly greater than the 50-year flood. Flooding damaged about 1,400 acres of land.

A suspended-sediment measurement in South Fork John Day River at Dayville January 30 at the peak discharge indicated a concentration of 3,780 ppm and a transport rate of about 40,000 tons per day. Floods in the Middle and North Forks were greater in January than in December. The peak discharge of 33,400 cfs January 30 in North Fork John Day at Monument (site 920), for example, exceeded the record peak of December and was 173 percent of that for a 50-year flood.

Downstream at the John Day River station at McDonald Ferry (site 926), the peak discharge of 41,400 cfs February 1 was slightly less than that in December, but exceeded the historic flood of 1894. Sediment concentrations were much lower than during December, and the maximum daily load consequently was less than a sixth of

FIGURE 37.—Bridge collapse, Interstate Highway 80N, at mouth of John Day River 29 miles east of The Dalles, Oreg., flood of December 23, 1964. Photograph by U.S. Army Corps of Engineers.

that in December. However, the load transported during the January flood was about twice that for the flood of February 1963. Estimated flood damage in January was $1,043,000 along the main stem and $866,000 in tributary basins.

The discharge hydrographs for stations on John Day River at Picture Gorge near Dayville and at McDonald Ferry for the period December 16–February 15 are included in figure 31. Graphs of suspended-sediment concentration and load and stream discharge at the McDonald Ferry station for the periods December 20–30 and January 26–February 5 are shown in figure 33.

OTHER AREAS OF FLOODING BETWEEN SNAKE AND DESCHUTES RIVERS

Small tributaries of the Columbia River in Oregon and Washington were raging torrents in December, carrying rocks and debris and causing extensive damage. Girkling Creek ripped through Rufus, Oreg., eroded the town's trailer park, and deposited sediment and debris over much of the town. The town water supply was washed out, and all communications to the town were severed. Interstate Highway 80N was covered with debris and mud for about a quarter of a mile. In Fulton Canyon tributary near Wasco (site 934), the peak discharge of 1,370 cfs December 21 was equivalent to a runoff

FIGURE 38.—Washed-out approach to railroad bridge on Alder Creek, Wash., flood of December 23, 1964. Photograph by U.S. Army Corps of Engineers.

of 203 cfs per sq mi. High flows in Spanish Hollow at Biggs Junction washed out sections of U.S. Highway 97 and the approaches to bridges on State Highway 97 and Interstate Highway 80N. Erosion of a railroad embankment at Biggs caused a caboose and four cars of a freight train to roll into the creek. A boy died as a result of an automobile accident caused by a washed-out bridge approach south of Biggs. Flooding caused extensive damage to highway relocation works and hampered construction work at John Day Dam. Highways and railroads along the Columbia River in Washington were also blocked by water, sediment, and debris (fig. 38). The peak discharge of Alder Creek at Alderdale, Wash. (site 896), was 17,600 cfs December 22, and the estimated maximum daily suspended-sediment load was 180,000 tons. Two trains were stalled by the flood at Roosevelt, Wash., and food for the 300 stranded passengers was parachuted to the town. Damage in the area from the December flood was about $2.4 million.

In late January the floods and damage were not extensive. The most severe flooding occurred on the south slope of the Horse Heaven Hills, southeast of Pasco, Wash., but flood peaks were smaller throughout the rest of the area. Overflows from Alder Creek and Pine Creek in Washington flooded roads, and floodwaters closed U.S. Highway 30 at Rufus, Oreg., for about a day. Flood losses in January were about $390,000.

DESCHUTES RIVER BASIN

Despite the storage and regulation provided by Prineville and Ochoco Reservoirs, Lake Billy Chinook, and several other reservoirs, the floodflow in Deschutes River at Moody, Oreg. (site 973), near the mouth, reached a record high of 75,500 cfs December 22, more than 170 percent of the previous maximum in a 61-year record. The sediment transport rate was also very high, as shown by the suspended load of 1.8 million tons per day measured at Moody 20 hours after the peak. The discharge hydrograph for this station for the period December 16–February 15 is included in figure 31. During the most critical period of the flood, Prineville Reservoir on Crooked River and Lake Billy Chinook on Deschutes River each stored inflow at the rate of about 15,000 cfs. The peak discharge of 12,800 cfs December 22 in Beaver Creek, a tributary of upper Crooked River, near Paulina (site 954) was 3.5 times the previous record flow and 4.1 times the magnitude of the 50-year flood. In the Crooked River upstream from Prineville Reservoir near Post (site 956), the peak discharge of 19,700 cfs December 23 was 1.9 times the magnitude of the 50-year flood. Storage in Prineville Reservoir effectively reduced and delayed the record inflow to a controlled discharge of 3,300 cfs December 30.

Peak discharges in the Deschutes River and tributaries upstream from the Crooked River were delayed by the natural high porosity of the volcanic material which underlies the basin. The floodflows in Deschutes River below Bend (site 949) reached a peak of only 2,820 cfs December 27, well below the 1909 peak of 4,820 cfs.

Most of the discharge contributing to record flow in the Deschutes River at Moody (drainage area, 10,500 sq mi) December 22 came from the 3,000-square-mile drainage area downstream from Lake Billy Chinook. The outflow from Lake Billy Chinook which contributed to the peak flow at Moody was only about 4,000 cfs. The intervening inflow of 70,000 cfs between the Madras gage and the river mouth is outstanding for this section of the Deschutes River basin. The flows in Shitike Creek and Warm Springs River were exceptionally high. Shitike Creek washed out a bridge approach and caused damage in the town of Warm Springs, 11 miles northwest of Madras. Kahneeta Resort, near the Warm Springs River, was heavily damaged. Two women were drowned when their car plunged off a washed-out bridge into the Warm Springs River. Total damage to Indian Agency property was about $900,000. Flood losses in the basin were nearly $4 million and included extensive damage to roads and bridges, Forest Service roads, park facilities, and agricultural damage. Runoff from the January storms caused only minor flooding.

KLICKITAT RIVER BASIN

Floodflows in December exceeded prior recorded flows in most of the Klickitat River basin in southern Washington. At the Klickitat River station near Pitt (site 984), the peak discharge of 31,100 cfs December 23 from the 1,297-square-mile basin exceeded the previous record flow of 25,500 cfs in 1933, and the magnitude was equivalent to that for a 50-year flood. Flood losses of more than $1.1 million occurred principally along the Little Klickitat River and included damage to homes, roads, bridges, and railroad facilities. The January storms did not cause significant floods in the basin.

HOOD RIVER BASIN

Peak discharges in the Hood River basin in Oregon resulting from the December 19–23 storm were exceptionally high. The record-high flows demolished the gaging station on Hood River near Hood River, which was reestablished 4 miles upstream at Tucker Bridge (site 988). The peak discharge of 33,200 cfs December 22 at Tucker

Bridge nearly equaled the 1923 record flow of 34,000 cfs at the Hood River station. Because the drainage area of 279 square miles above Tucker Bridge is 15 percent less than that at Hood River and flows in streams in the intervening area were high, the December flow is considered the highest in the 52-year period of record at the station near Hood River.

Bank cutting along the river was severe. Sections of a spur railroad track and a trestle were destroyed. Many washouts occurred along the Pacific Power and Light Co. diversion. Damage to irrigation facilities was especially heavy, and flood losses were more than $3.2 million.

WHITE SALMON RIVER BASIN

Floodflows in December were comparable to previous record flows in the White Salmon River and its tributaries in Washington. The peak discharge of 9,640 cfs December 23 at the downstream gaging station on White Salmon River near Underwood (site 993) nearly equaled that in 1917, the highest discharge in 47 years of record, and the magnitude was equivalent to a flood having a 37-year recurrence interval.

WIND RIVER BASIN

Record peak flows occurred in the lower reaches of the Wind River in Washington. The peak discharge of 28,300 cfs December 23 at the station near Carson (site 998) was 107 percent of the maximum in 31 years of record, and 1.2 times the magnitude of the 50-year flood. Farther upstream, above Trout Creek, the floodflows were slightly less than previous record flows.

SANDY RIVER BASIN

Heavy runoff in December produced record flows throughout most of the Sandy River basin in Oregon. All streams began to rise the morning of December 21 and peaked the late afternoon of December 22. The peak discharge of 1,300 cfs in Salmon River near Government Camp (site 999) was nearly twice the previous maximum flow in a 40-year record. At the Sandy River station near Marmot (site 1000), the peak flow was the highest in 55 years of record and 2.1 times the previous record flow in 1923. Heavy sediment loads were transported by the Sandy River and its tributaries, but no sediment data are available. Peak discharges in the Bull Run River basin generally equaled or exceeded the previous maximums. The combined discharge of the upper Sandy and Bull Run Rivers produced a peak discharge of 84,400 cfs December 22 in the Sandy

River near Bull Run (site 1007), 1.4 times the discharge of the 50-year flood at that site. Bull Run Reservoir 2 and Lake Ben Morrow, which are used only for storing the Portland municipal water supply and for some power generation, could not provide any flood control because they were full when the flood occurred. As a result of heavy sediment concentrations in the inflowing streams, the Portland water supply was turbid for several days.

In the Mount Hood area the rampaging Zigzag and Sandy Rivers and smaller tributaries destroyed many homes, cabins, bridges, and roadways. Sediment and debris deposited by Wildcat Creek near Brightwood blocked State Highway 26 for several days. One man was killed when his house was smashed by a landslide. Two bridges were destroyed upstream from Rhododendron, and about 80 people were isolated. Flood losses exceeded $5.5 million.

Warming temperatures and heavy rains in late January again resulted in the melting of snowpacks and produced heavy runoff at the higher altitudes in the Sandy River basin. At the Salmon River station near Government Camp (site 999), the peak discharge of 729 cfs January 29, though only 56 percent of that in December, was the second highest in 40 years of record. Downstream the flood peak was attenuated, but was still an outstanding event. Flood damage in the Sandy River basin during January, however, was minor. The discharge hydrograph for Sandy River below Bull Run River, near Bull Run, for the period December 16–February 15, is included in figure 31.

OTHER AREAS OF FLOODING IN THE LOWER COLUMBIA RIVER BASIN DOWNSTREAM FROM DESCHUTES RIVER

Most of the small tributaries of the Columbia River between the Deschutes River and Vancouver, Wash., had extremely high flows in December. Flood losses consisted principally of damage to roads and bridges and the flooding of some lowlands. Outstanding peak discharges occurred in the Mill Creek basin near The Dalles, Oreg. High flows in Mosier Creek near Mosier, Oreg., washed out a bridge approach and destroyed the gaging station 3 miles upstream from the creek mouth. Homes at Washougal and Camas, Wash., were threatened by the Columbia River floodwaters, but serious flooding did not materialize.

Along the Columbia River main stem, upstream from the influence of the Willamette River, floodflows were low in relation to major summer floods. The daily discharge of 364,000 cfs December 25 in the Columbia River at The Dalles (site 975), however, was the highest winter discharge since December 25, 1933, and that of 314,000 cfs January 31 was the second highest. Heavy debris and sediment loads from the extreme floods in tributary streams caused operational problems at the Bonneville and The Dalles Reservoirs, but flood damage generally was minor. Floodflow relations along the main stem in the flood area upstream from Vancouver are illustrated in figure 39, which presents discharge hydrographs for the period December 16–February 15 for the stations below Priest Rapids Dam and at Pasco, Wash., upstream from the Snake River, and for the stations downstream below McNary Dam, at The Dalles, and at Vancouver. The data from the Priest Rapids, Pasco, and The Dalles stations are for daily discharge only.

At Vancouver the observed peak stage on the Columbia River was 29.4 feet December 25, 1.7 feet above major flood stage and approximately equal to the high stage of the June 1956 flood. The peak stage of December 25, 1964, was due in large part to the effect of very high discharge from the Willamette River just downstream; that of June 1956 was not. The discharge reached a maximum of 550,000 cfs, suspended-sediment concentration reached 3,970 ppm 8 hours later, and the maximum daily sediment load transported was 3.5 million tons the same day. The Corps of Engineers estimated that storage in the major Snake River reservoirs and in reservoirs in the upper Columbia River basin lowered the December flood stage in the Columbia River in the Portland-Vancouver area by about 2 feet, and regulation by Columbia and Willamette basin storage reservoirs lowered the stage by about 5 feet. On Sauvies Island, in the Columbia River at the mouth of the Willamette River, pasturelands were flooded as a result of the high stages produced by the combined flows of the two rivers. Several thousand acres of pastureland was flooded along Lower River Drive in Vancouver, and some cattle were drowned.

Downstream from Vancouver and the mouth of the Willamette River the Columbia River flood in December was the greatest winter flood in history, though the peak discharge was less than that for the great June floods of 1894 and 1948. At Kalama, Wash., a plywood plant and a chemical plant sustained heavy water damage. Commercial and industrial properties, principally in timber-based industries, sustained a large part of the flood damage in the area. The Cowlitz River flood crest at the mouth was 2 feet above flood stage, and floodwater spilled over the dike near Kelso, but damage was minor. Flood losses along the lower Columbia River main stem were more than $2.1 million.

The floods in January were generally not severe, but the heavy rains caused numerous landslides along the lower Columbia River.

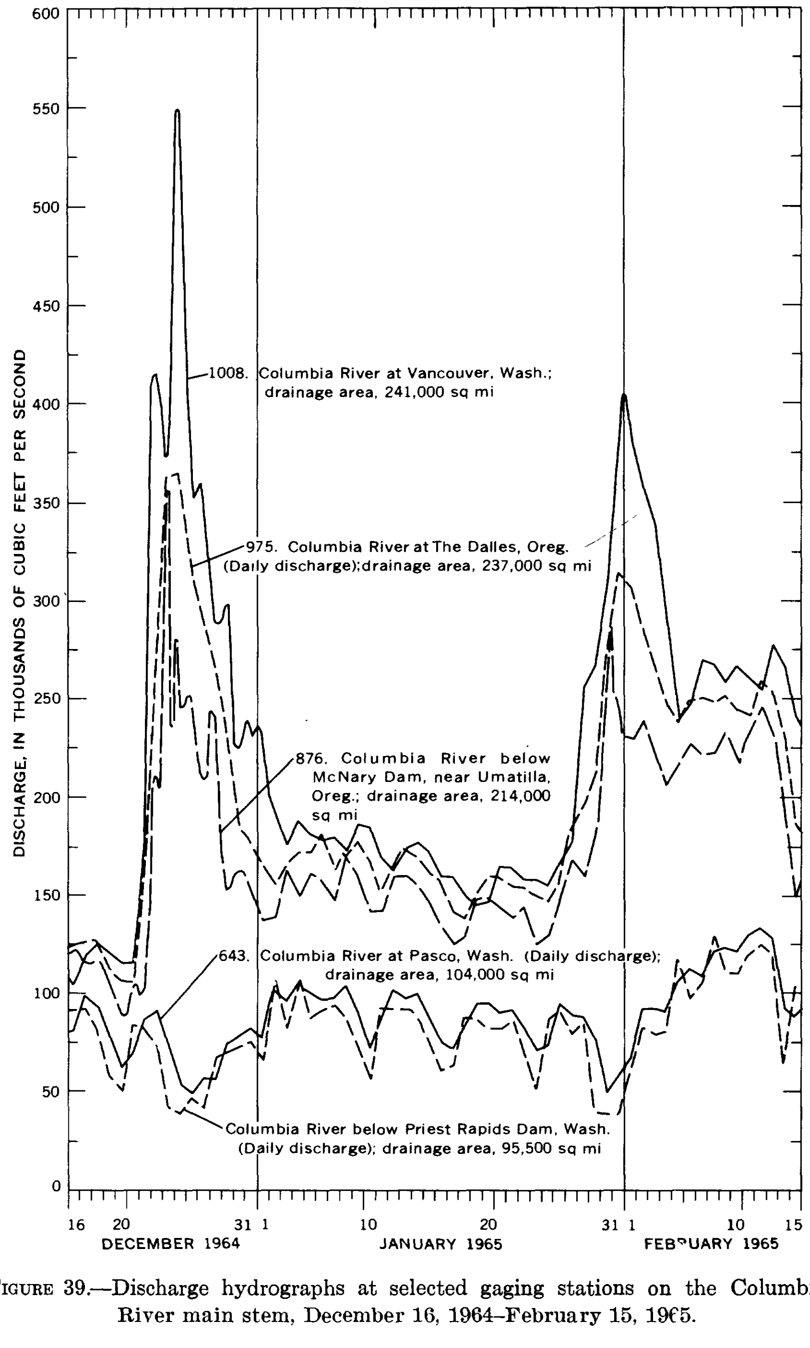

FIGURE 39.—Discharge hydrographs at selected gaging stations on the Columbia River main stem, December 16, 1964–February 15, 1965.

WILLAMETTE RIVER BASIN

The same sequence of weather events that caused extra flooding in many areas in the Far Western States in late December produced extraordinary floods throughout the Willamette River basin in Oregon. The location of the region in the flood area is shown in figure 1 (hydrologic region 6), and the location of sites 1009 to 1136, for which streamflow and some sediment-transport data are available, is shown in figure 40.

A major storm moved onto the Oregon coast December 18 and brought heavy snow to most of the area. Near-record depths accumulated on the slopes of the Coast and Cascade Ranges and on the floor of the Willamette Valley. On December 20 rapidly rising temperatures, which raised the freezing level to almost 10,000 feet, were accompanied by heavy rains. Frozen-soil conditions, which were caused by extremely cold temperatures December 16 and 17, prevented normal infiltration into the soil, and immediate runoff resulted. The December 19–23 storm brought as much as 15 inches of rain to valley areas and as much as 18 inches to the higher altitudes in the Cascade Range (fig. 2). The heavy rains, supplemented by large quantities of snowmelt, produced floods that have not been equaled in more than 100 years in many parts of the Willamette River basin.

Knowledge of floods in the Willamette River basin begins with the widespread deluge and flood of 1861; there is some evidence that the flood of 1861 was the greatest in the basin since at least 1813 (Brands, 1947). Many major floods have occurred in the basin since that time; some have covered the entire basin, whereas others were severe only in parts of the basin. Basinwide floods of record were those in 1861, 1890, 1923, 1945, 1955, and December 1964. Very little quantitative information is available for the floods of 1861 and 1890, except that obtained at main-stem gaging stations. The meager data indicate that prior to December 1964, the floods of December 1861 were the highest, followed by those of February 1890. Corps of Engineers studies of flood reduction by flood-control reservoirs indicate that, without the present degree of flood control, the floods of December 1964 would have been generally higher throughout the basin than the 1890 floods; almost as high as the 1861 floods in the upper basin; and somewhat lower than the 1861 floods in the lower basin except, possibly, in the Portland Harbor. If flood-control facilities did not exist the combined effect of the high flows in the Columbia and Willamette Rivers in December 1964 might have resulted in a higher stage at Portland than that in 1861.

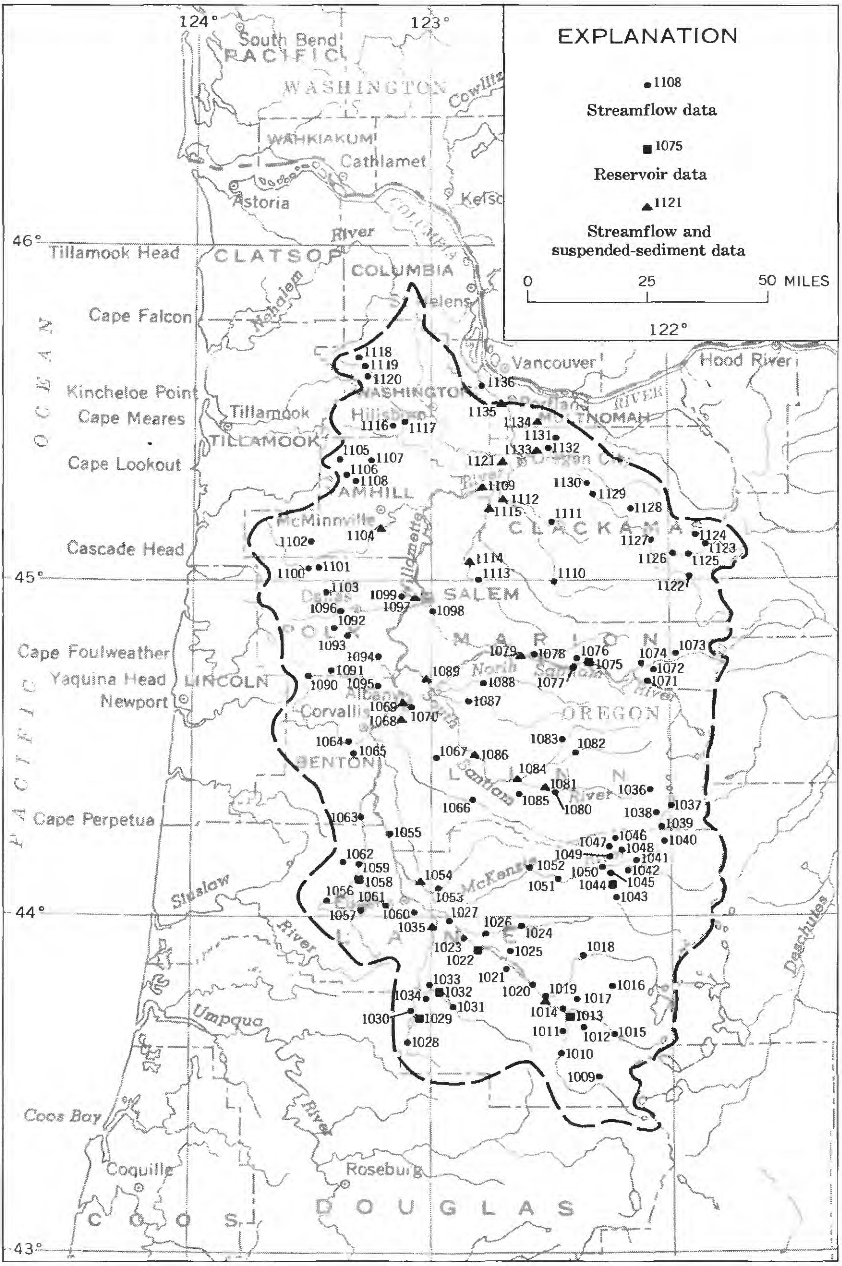

FIGURE 40.—Location of flood-data sites (1009–1136) in the Willamette River basin. Numbers refer to those in tables 19 and 20.

The floods of December 1964 in the Willamette River basin dwarfed those of 1955. The Corps of Engineers estimated that, without the regulation afforded by reservoir storage, the p^ak dis-

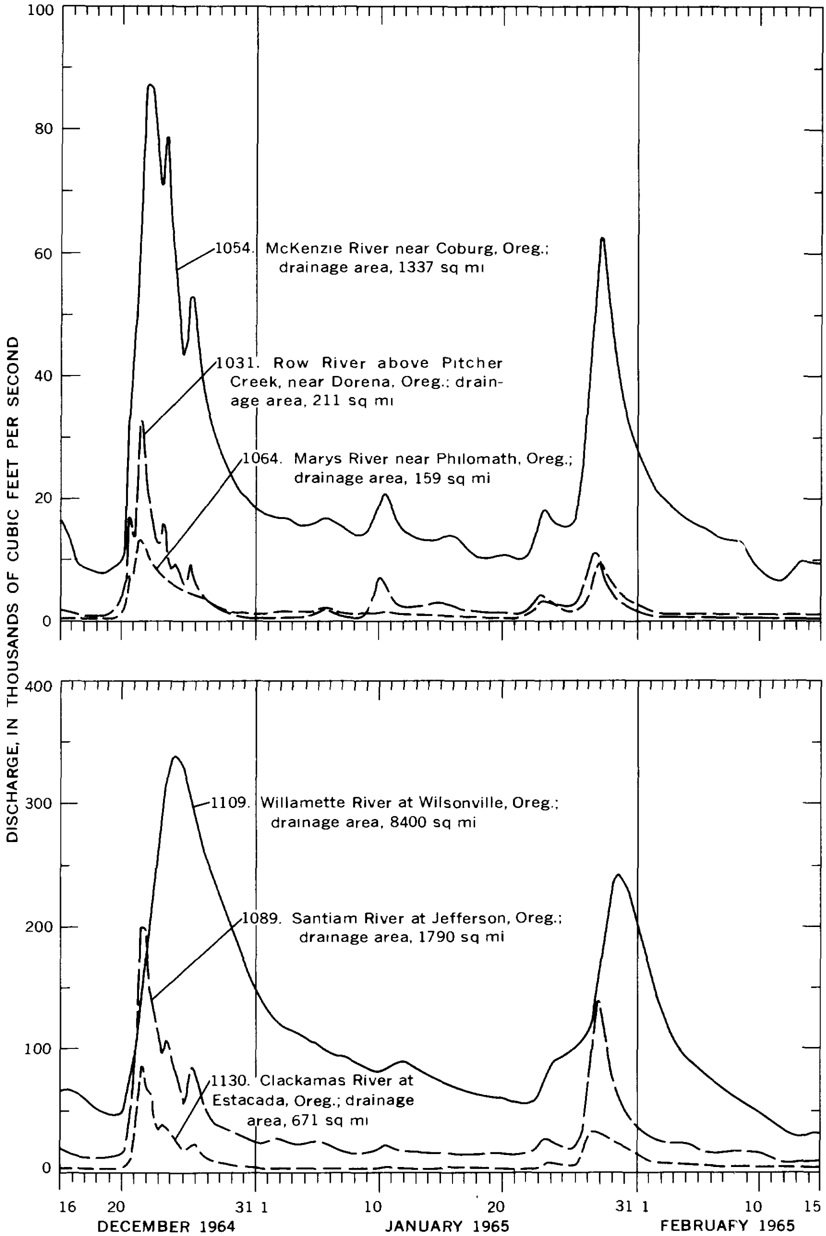

FIGURE 41.—Discharge hydrographs at selected gaging stations in the Willamette River basin, December 16, 1964–February 15, 1965.

charge of the Willamette River at Oregon City in 1964 would have been 545,000 cfs; by similar computation the unregulated peak discharge in 1955 would have been 332,000 cfs. The actual peak December 25, 1964, was 443,000 cfs at Portland.

The floods in late January were not outstanding in the Willamette River basin. The highest flows occurred in the central part of the valley along the slopes of the Coast Range, but the magnitudes at gaging stations generally did not exceed those for floods having 20-year recurrence intervals. The high flows that occurred were caused by runoff from warm rains and melting snow.

Sediment-discharge measurements were made at several sites in the basin during the principal flood periods in December and January. Measurements obtained at near-peak discharge at some sites indicated suspended-sediment concentrations several times greater than the maximums measured during a study conducted by the Corps of Engineers during 1949–51.

Three lives were lost, and more than 210,000 acres of agricultural land was inundated in the Willamette River basin. Flood losses were more than $65 million.

The discharge hydrographs at selected gaging stations in the basin for the period December 16–February 15, shown in figure 41,

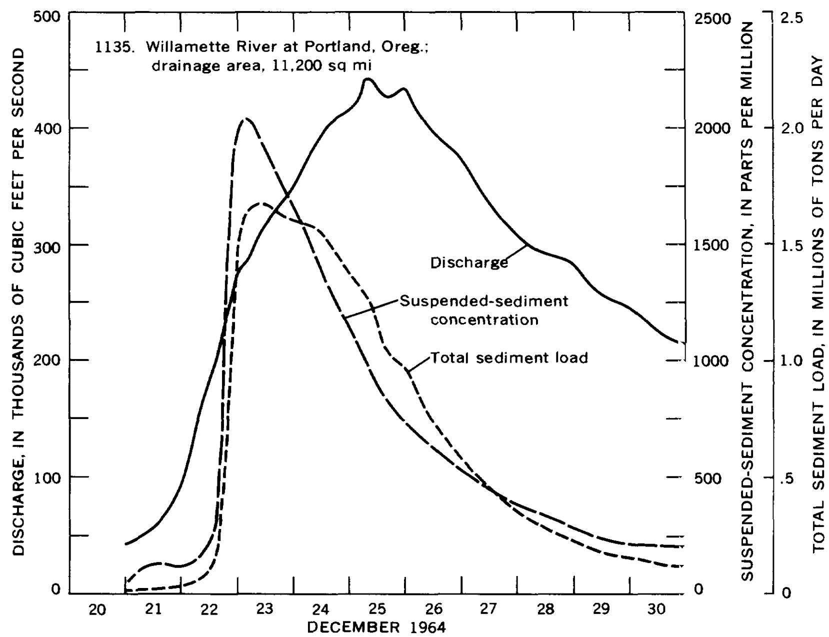

FIGURE 42.—Graps of suspended-sediment concentration, total sediment load, and stream discharge in the Willamette River at Portland, Oreg., December 21–30, 1964.

demonstrate the relative magnitude of the December and January floods. The graphs of suspended-sediment concentration, total sediment load, and stream discharge in the Willamette River at Portland for the period December 21–30, 1964, shown in figure 42, indicate the relation between the sediment transport and discharge.

WILLAMETTE RIVER BASIN UPSTREAM FROM THE McKENZIE RIVER

Heavy rains and snowmelt in late December caused record-high and extremely damaging floodflows in the upper Middle Fork Willamette River basin. At Oakridge 10.77 inches of precipitation occurred December 19–23, and 8.17 inches was recorded at Lookout Point Reservoir 20 miles southeast of Eugene during the same period. The peak discharge of 11,600 cfs December 23 in Salmon Creek near Oakridge (site 1017) was representative of the runoff in the Middle Fork basin. This discharge was 110 percent of the previous maximum flow in December 1956, and 1.4 times the magnitude of the 50-year flood. The gaging station on Middle Fork Willamette River above Hills Creek Reservoir was destroyed, and large deposits of gravel and boulders restricted the capacity of the channel upstream from the fish hatchery near Oakridge. High flows demolished the gaging station on Salmon Creek also and generally devastated the channel. Bridge washouts at Deception Creek between Eugene and Oakridge and slides and washouts upstream from Oakridge on Salt Creek stranded many travelers for several days. The Southern Pacific Co. was forced to cancel railroad service for more than a week. The Edward Hines Lumber Co. dam across the North Fork Middle Fork Willamette River at Westfir was destroyed, and many logs were washed away.

Hills Creek and Lookout Point Reservoirs on the Middle Fork Willamette River stored most of the inflow and greatly reduced flooding and damage downstream. The maximum inflow of 60,800 cfs (U.S. Army Corps of Engineers, 1966b, p. 50) to Lookout Point Reservoir probably occurred December 22, and the maximum outflow 4 days later was only 29,500 cfs.

Floods in the Coast Fork Willamette River basin were comparable to those in the Middle Fork. Precipitation December 19–23 was 8.88 inches at Cottage Grove Dam and 8.31 inches at Dorena Dam. The peak discharge of 12,500 cfs December 22 on Coast Fork Willamette River at London (site 1028), upstream from Cottage Grove Reservoir, was 142 percent of the previous maximum in December 1945 and 1.2 times the magnitude of the 50-year flood. Floodflows in Row River near Dorena (site 1031), upstream from Dorena Dam, were exceptionally high; the discharge was

169 percent of the previous maximum in 1945. The discharge hydrograph for this station is included in figure 41. The high flows along the Coast Fork flooded several homes and damaged a new bridge. The rampaging Row River swept away three houses and several garages. Roads were washed out in many places. Sandbagging of levees helped to reduce flooding near Cottage Grove; however, many people evacuated their homes as a precautionary measure, and patients were removed from a nursing home.

Storage in Cottage Grove Reservoir on the Coast Fork Williamette River and in Dorena Reservoir on Row River reduced floodflows, although all flood-control storage space was eventually used and spillway overflow occurred. Peak inflow of 38,000 cfs occurred in Dorena Reservoir December 22; within 6 hours the reservoir began to spill, but the outflow from the reservoir reached a maximum of only 17,200 cfs December 23. Storage in Cottage Grove Reservoir modified the peak inflow of 12,500 cfs December 22 to a peak outflow of 5,910 cfs December 24. The Corps of Engineers estimated that the flood storage reduced the peak flow of Coast Fork Willamette River near Goshen (site 1035) by 41,000 cfs and lowered the stage from 22.5 to 17.1 feet. However, the modified stage reached was still 1 foot above major flood stage.

The combined regulated flows from the Middle and Coast Forks produced a peak of 60,000 cfs (estimated by the Corps of Engineers) in the Willamette River at Eugene. A peak discharge of 60,000 cfs has been exceeded many times at this site prior to construction of upstream flood-control reservoirs. The corresponding peak stage of 24.2 feet was 1.2 feet above flood stage. Lowland flooding from the Willamette River, aggravated by high stages on the McKenzie River in the Eugene area, forced many residents to leave their homes.

Damage to channel improvements and river-control structures constituted 45 percent of the $2 million flood loss in the basin upstream from the McKenzie River.

WILLAMETTE RIVER BASIN FROM McKENZIE RIVER TO SALEM, OREGON

The principal tributaries of the Willamette River between Eugene and Salem are the McKenzie, Calapooia, and Santiam Rivers from the east and the Long Tom, Marys, and Luckiamute Rivers and Muddy and Rickreall Creeks from the west. During the December 19–23 storm, 7.46 inches of precipitation was observed at Corvallis in the Willamette Valley, 14.82 inches at Falls City No. 2 in the Coast Range 20 miles west of Salem, and 17.86 inches at Belknap Springs in the Cascade Range 55 miles east of Eugene. Precipitation at these same stations during the January 21–31 storm was 8.44, 10.96, and 10.83 inches.

In the McKenzie River basin, the floodflows in unregulated streams were record high in December. The peak discharge of 19,100 cfs December 22 in McKenzie River at McKenzie Bridge (site 1041) was the highest in 54 years of record and 6 percent greater than the 50-year flood. Cougar Reservoir stored floodflows from the South Fork McKenzie River; inflows reached a peak of 35,000 cfs December 22 (Corps of Engineers), while outflows reached a peak of only 6,220 cfs January 8 at the station near Rainbow (site 1045). At the gaging station near Coburg (site 1054), near the mouth of the McKenzie River, the peak discharge of 87,300 cfs December 23 was nearly equal to the maximum flow of record.

Flood damages along the McKenzie River were extensive. The main powerplant of the Carmen-Smith Hydroelectric Project, operated by Eugene Water and Electric Board, was flooded by backwater caused by logs and debris piling up on Trail Bridge Dam. Floodwaters destroyed 11 houses near Blue River and McKenzie Bridge. Surging flood waves from landslides and washed-out debris dams along the Blue River contributed to destruction of the gaging stations on Blue River below Tidbits Creek and near Blue River. In the lower McKenzie River valley, damage was restricted to roads, bridges, farms, and undeveloped land.

Downstream from the McKenzie River, the Willamette River at Harrisburg (site 1055) reached a stage of 17.25 feet December 23, 5 feet above flood stage, and a peak discharge of 125,000 cfs. The Corps of Engineers estimated that, without regulation by upstream reservoirs, the peak discharge would have been 280,000 cfs at a stage of 20.5 feet. The peak stage at this site during the flood of 1861 was about 21 feet. Wide areas of agricultural land between Harrisburg and Junction City were inundated, and eight persons were evacuated by helicopter from Browns Landing near Junction City.

Floods in the Long Tom River basin were not exceptional, and storage in Fern Ridge Reservoir reduced downstream peak flows. Marys River reached a peak discharge of 13,600 cfs December 22 at the station near Philomath (site 1064), 113 percent of that in 1955; the flood-plain overflow was a mile wide. Near Corvallis, floodwater from the Long Tom River and Muddy Creek, backed up by high stages in the Willamette River, formed a huge lake about 10 miles wide and forced closure of U.S. Highway 99W.

At Albany additional high runoff from the Calapocia River contributed to the peak stage of 33.93 feet December 24 in the

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Willamette River. The estimated unregulated peak stage (table 19) would have been 40.2 feet (1967 datum), higher than those in 1881 and 1890 but slightly below the stage of 41.0 feet in 1861. Damage in the Albany area resulted mainly from flooding of homes, farmland, and roads, including Interstate Highway 5 north of Albany. In North Albany, a woman was drowned, and families were evacuated by train.

Peak flows were particularly high in the Santiam River basin. The highest runoff at gaged sites in Oregon during the flood period occurred in Quartzville Creek near Cascadia (site 1083), where the peak discharge of 36,500 cfs December 22 was equivalent to a runoff of 368 cfs per sq mi. Runoff in the North Santiam River was lower, but the peak discharge at the gaging station below Boulder Creek (site 1071), above Detroit Reservoir, was 131 percent of the previous maximum flow and 1.3 times that for a 50-year flood. In spite of the regulation afforded by Detroit Dam, the combined runoff from the North Santiam River basin downstream from the dam and from the South Santiam River and Middle Santiam River basins produced a peak discharge in Santiam River at Jefferson (site 1089) that was only 3 percent less than the record maximum of 202,000 cfs at a stage of 24.4 feet in 1921 prior to the construction of Detroit Dam. Storage of inflow in Detroit Reservoir reduced an estimated unregulated peak discharge of 255,000 cfs at a stage of 26.1 feet at Jefferson to the observed flow of 197,000 cfs at a stage of 24.2 feet, 9 feet above flood stage. Sediment transport was especially high, for the basin, at this site. Almost 4 days after the flood peak, the suspended-sediment concentration was still more than 1,000 ppm, and the suspended load was equivalent to more than 200,000 tons per day.

Flood damage was extensive throughout the Santiam River basin, and inundation and erosion of croplands was particularly severe. A large mud slide blocked State Highway 22 at Detroit Dam for several days, and at Idanha, on the upper North Santiam River, nine homes were washed away and the community was isolated for several days. A switching facility was washed out just downstream from Detroit Dam, and the powerplant was isolated from the Bonneville Power Administration system. The gaging station on Quartzville Creek near Cascadia was destroyed. Landslides along Quartzville Creek and its tributaries blocked the Quartzville road for nearly a month. A fish hatchery on Quartzville Creek also received considerable damage. Washout of a cofferdam at the construction site of Green Peter Dam on the Middle Santiam River caused damage estimated at $1.5 million. Logs released from a jam upstream completely filled the Wiley Creek channel at the town of Foster.

In the upper Luckiamute River basin the peak discharges were not outstanding, but at the downstream gaging station near Suver (site 1094) the peak discharge of 32,900 cfs December 22 was record high and 1.1 times the 50-year flood.

Floodwaters from the Willamette, Santiam, and Luckiamute Rivers inundated many homes and farms in the lowlands along the Willamette River. Helicopters were used to evacuate many people in the vicinity of Buena Vista, downstream from the Luckiamute River. At Salem, the Willamette River December 23 reached a peak discharge of 308,000 cfs at a stage of 37.78 feet, nearly 10 feet above flood stage. Twenty-four hours after the flood peak, the suspended-sediment concentration was still 900 ppm, and the river was transporting sediment in suspension at a rate of about 730,000 tons per day. The Keizer residential area north of Salem was severely flooded (fig. 43); about 4,000 people were forced to leave their homes, and water levels were higher than the windowsills in about 400 homes. The Salem Memorial Hospital was evacuated. Without the regulation by upstream flood-control reservoirs the flood stage at Salem would have been 7.5 feet higher (tables 15

FIGURE 43.—Keizer area, north of Salem, Oreg., flooded by Willamette River, December 23, 1964. Photograph, courtesy U.S. Army Corps of Engineers.

and 18), or about 1.7 feet below that of 1861 and about 0.2 foot above that in 1890, according to the Corps of Engineers.

Steady rains in late January caused streams to rise again and brought a recurrence of flooding in some areas. The flow in Marys River near Philomath (site 1064) reached a peak of 11,200 cfs January 28, 93 percent of that in 1955. The peak discharge of 137,000 cfs in Santiam River at Jefferson (site 1089) January 28 was 69 percent of that in December; the largest contribution was from the South Santiam River. At the South Santiam River station at Waterloo (site 1086), the peak discharge of 67,500 cfs January 28 was only 71 percent of that in December, but the sediment concentration was especially high. On January 29, 22 hours after the flood peak, the suspended-sediment concentration was still 2,000 ppm, equivalent to a daily suspended-sediment load of 223,000 tons. The suspended-sediment load transported by the Santiam River at Jefferson 4 hours after the observation at Waterloo was 255,000 tons per day, indicating that a large part of the load was coming from the South Santiam River. Floodflows were high in many small streams around Albany and Corvallis. At Albany the Willamette River crested 2 feet above flood stage, but downstream at Salem the flood crest barely reached flood stage.

The January floods caused some damage but not as much as the floods in December. Debris-cleaning operations in the Wiley Creek channel at Foster were hindered by the deposition of additional logs and debris. On January 28 nearly 200 farm families were isolated by high water near Albany and Jefferson; Interstate Highway 5 was blocked near Albany for several hours; and a railroad dike and a trestle of the Southern Pacific Co. were washed out north of Albany. At Salem, sandbag crews again worked around the clock to protect a hospital and the school for the blind.

Flood losses in the Willamette River basin from the McKenzie River to Salem were nearly $28 million, of which about $10 million was agricultural.

Discharge hydrographs for McKenzie River near Coburg, Santiam River at Jefferson, and Marys River near Philomath for the period December 16–February 15 are included in figure 41.

WILLAMETTE RIVER BASIN DOWNSTREAM FROM SALEM, OREGON

Unprecedented peak discharges occurred in late December on all streams in the lower Willamette River basin, except those in the Tualatin River valley, where peak discharges were relatively low. January peaks in the Willamette River basin downstream from Salem, however, were not outstanding.

Peak discharges in the Yamhill River basin December 22–23 exceeded prior maximum flows and were generally more than 1.2 times the magnitude of the 50-year floods. At the South Yamhill River station near Willamina (site 1100), the peak discharge of 19,600 cfs December 22 was the highest in 31 years of record and 1.2 times the magnitude of the 50-year flood. The cableway at this gage was pulled down by the Gold Creek bridge, which had been washed out about 2 miles upstream. The North Yamhill River at Pike (site 1107) crested December 22 at a stage 0.4 foot below that in December 1955, although the peak discharge was 1.2 times the magnitude of the 50-year flood.

Peak flows on the Molalla and Pudding Rivers were the maximums of record at all gaging stations. In Molalla River near Canby (site 1112), the peak discharge of 43,600 cfs December 22 was 174 percent of the prior record flow and 1.4 times the magnitude of the 50-year flood. The suspended-sediment concentration at this station was particularly high and had declined only to 1,930 ppm 2 days after the peak. The Pudding River at Aurora (site 1115) had a peak discharge December 23 a little greater than the previous maximum; suspended-sediment transport was relatively light, and the suspended-sediment concentration was only 263 ppm 33 hours after the peak. Flood damage in the Molalla and Pudding River basins resulted mainly from inundation of lowlands. Many cattle were drowned, and damage from erosion and deposition of sediment and debris on the low pasturelands along both rivers was heavy. Several families were rescued from flooded homes along the Molalla River. The approach to the State Highway 213 bridge over the Molalla River was washed away.

Floods in the Tualatin River valley were less severe than those on other streams in the Willamette River basin. At the upper Tualatin River station near Dilley (site 1117), the maximum flow of 17,100 cfs December 22 was 130 percent of the record flow in 1955, but elsewhere in the basin the peak flows generally were lower than previous maximums.

The Willamette River reached a peak discharge of 339,000 cfs at Wilsonville (site 1109) December 25. Eighteen hours before the peak, the river was transporting suspended sediment at a rate of nearly 1 million tons per day and at a concentration of 1,080 ppm. Downstream from the mouth of the Yamhill River, many people abandoned their homes as the floodwater spilled over the riverbanks, and the Willamette River flood plain became a large lake.

Downstream below the falls and locks at Oregon City, the flood wave reached a maximum stage of 49.2 feet, 8 feet above flood stage, the morning of December 25 and almost drowned out Willamette Falls at Oregon City (fig. 44). The peak stage without regulation would have been 10.7 feet higher (tables 15 and 18).

Oregon City was paralyzed for several days—all entrances to the town were blocked by floodwater, except for State Highway 43 from West Linn, and much of the business district was flooded. Water rose to the level of windowsills in the 2-year-old Oregon City Shopping Center at the north end of town, causing heavy losses in food and merchandise; water also reached the third level of the Crown Zellerbach mill on the west side of the Willamette River. Many people were forced from homes in nearby West Linn and Lake Oswego.

In the Clackamas River basin the December flood was outstanding. In the upper Clackamas River at Big Bottom (site 1122), the peak discharge of 11,200 cfs December 22 was 165 percent of the record flow in 1946 and 1.2 times the magnitude of the 50-year flood. Downstream at the Estacada station (site 1130), the record flow of 86,900 cfs was 1.5 times the magnitude of the 50-year flood.

Flood damage was extensive throughout the Clackamas River basin. Utility damage was more than $2.3 million and included severe damage to the Faraday hydropower project. For a short

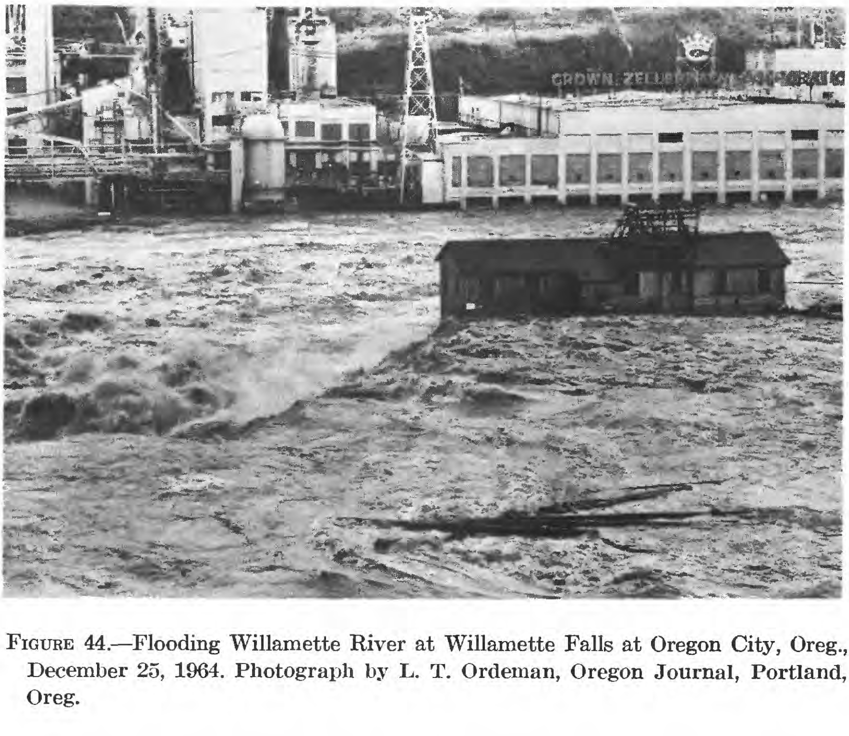

FIGURE 44.—Flooding Willamette River at Willamette Falls at Oregon City, Oreg., December 25, 1964. Photograph by L. T. Ordeman, Oregon Journal, Portland, Oreg.

time water overtopped the spillway gates at Timothy Lake Dam on Oak Grove Fork. The old Cazadero Dam on the Clackamas River washed away, but because the storage was small, the effect on downstream flow was minor. At Carver nearly all the trailers in a trailer camp were demolished or washed away. Many bridges in the basin were damaged or weakened by the flood and floating debris, and the road upstream from Estacada was closed by landslides and washouts for about 2 weeks. Gaging stations on the Clackamas River above Three Lynx Creek and near Clackamas were destroyed. The Clackamas River reached a peak discharge of 120,000 cfs December 22 near Clackamas (site 1133), and the high flows caused backwater in the Willamette River that contributed to the flooding in Oregon City and Gladstone (fig. 45). Hundreds of people were evacuated from their homes, some by helicopter. Almost 2 days after the flood peak near Clackamas, the Clackamas River was still transporting over a quarter of a million tons of suspended sediment per day at a concentration of over 1,800 ppm.

Flooding in the Portland area was extensive in December and was caused primarily by the high flows in the Willamette River combined with backwater from high stages in the Columbia River,

FIGURE 45.—Flooding at the confluence of the Willamette and Clackamas Rivers, Gladstone, Oreg., December 22, 1964. Photograph, courtesy U.S. Army Corps of Engineers.

and by high flows in local streams, notably Johnson Creek in southeastern Portland. The maximum discharge of 443,000 cfs occurred in the Willamette River at Portland at 0800 hours December 25; the maximum stage of 29.85 feet was observed at 1300 hours at the U.S. Weather Bureau gage on the Morrison Street bridge. This stage was nearly 12 feet above the flood stage and 4.8 feet above major flood stage. The December 25 stage was the highest winter peak since 1861, but was just below the crest stage of 29.98 feet in June 1948 and 3 feet lower than the 33.0-foot stage in June 1894, both caused by backwater from the Columbia River. During the highest part of the flood, December 22–28, more than 6 million tons of sediment was transported through the Portland Harbor, and suspended-sediment concentrations reached 2,050 ppm. Graphs of suspended-sediment concentration, total sediment load, and stream discharge in the Willamette River at Portland for the period December 21–30 are shown in figure 42.

Upstream regulation, afforded by storage in flood-control reservoirs, reduced flood stages in the Portland area by about 4.6 feet, and flood regulation in the Columbia River provided an additional reduction of 1 foot, as shown by Corps of Engineers studies.

Floodflows in the Willamette River caused considerable damage in and near Portland. Many houseboats broke loose from their moorings and were washed away or wrecked; an amusement park was completely inundated; and a floating restaurant was torn from its moorings. Water from the rising Willamette River lapped over the concrete floodwall, and sandbags were added to the wall to prevent flooding of downtown Portland. Spill over the floodwall caused closure of Harbor Drive and flooded the Union Railroad Station. There was no railroad service into or out of Portland for several days. As the river crested Christmas Day, tugboats worked feverishly to remove enormous quantities of debris from the piers of Portland's eight bridges (fig. 46). The Steel Bridge was closed when water washed over its lower deck. Levees downstream from Portland were sandbagged to protect lowlands. East of the Willamette River near Portland, the perennially flooding Johnson Creek reached its highest stage in 25 years of record, inundated a large area in southeastern Portland, and caused evacuation of many homes. The peak discharge of 2,620 cfs December 22 at the gaging station at Sycamore (site 1134) was 1.3 times the 50-year flood.

The flood losses in the Willamette River basin downstream from Salem were $35.5 million and included damages of nearly $15 million to commerce and industry, $6 million to agriculture, $5.6 million to residences, and $4 million to transportation. The discharge hydro-

FIGURE 46.—Debris piling on bridge piers on Willamette River at Portland, Oreg., December 25, 1964. Photograph by L. T. Ordeman, Oregon Journal, Portland, Oreg.

graphs for Willamette River at Wilsonville and Clackamas River at Estacada for the period December 16–February 15 are included in figure 41.

COASTAL OREGON

The coastal Oregon region consists of the Pacific slope basins in Oregon from the Necanicum River on the north to the Oregon-California border on the south. The location of the region in the flood area is shown in figure 1, and the location of sites 1137 to 1254, for which streamflow or sediment data are available, is shown in figure 47.

Severe flooding occurred in streams along the Oregon coast in late December 1964 as a result of the December 19–23 precipitation (fig. 2), and the melting of snow at low altitudes. In many streams, particularly in the central and south-coastal area, the resulting peak discharges were greater than those for floods with 50-year recurrence intervals. Peak discharges in December at some gaging stations in the Umpqua River and Rogue River basins were the highest in nearly 60 years of record. The flow of 265,000 cfs December 23

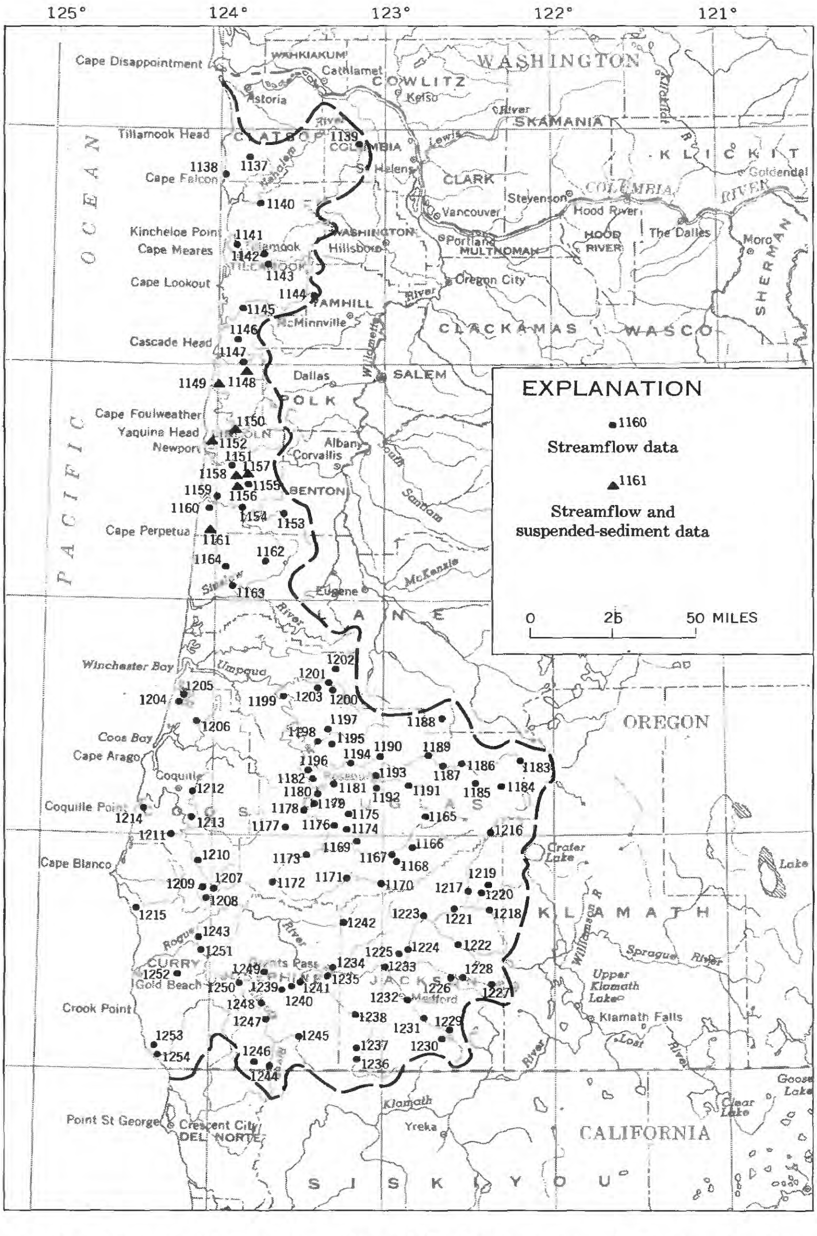

FIGURE 47.—Location of flood-data sites (1137–1254) in coastal Oregon. Numbers refer to those in tables 19 and 20.

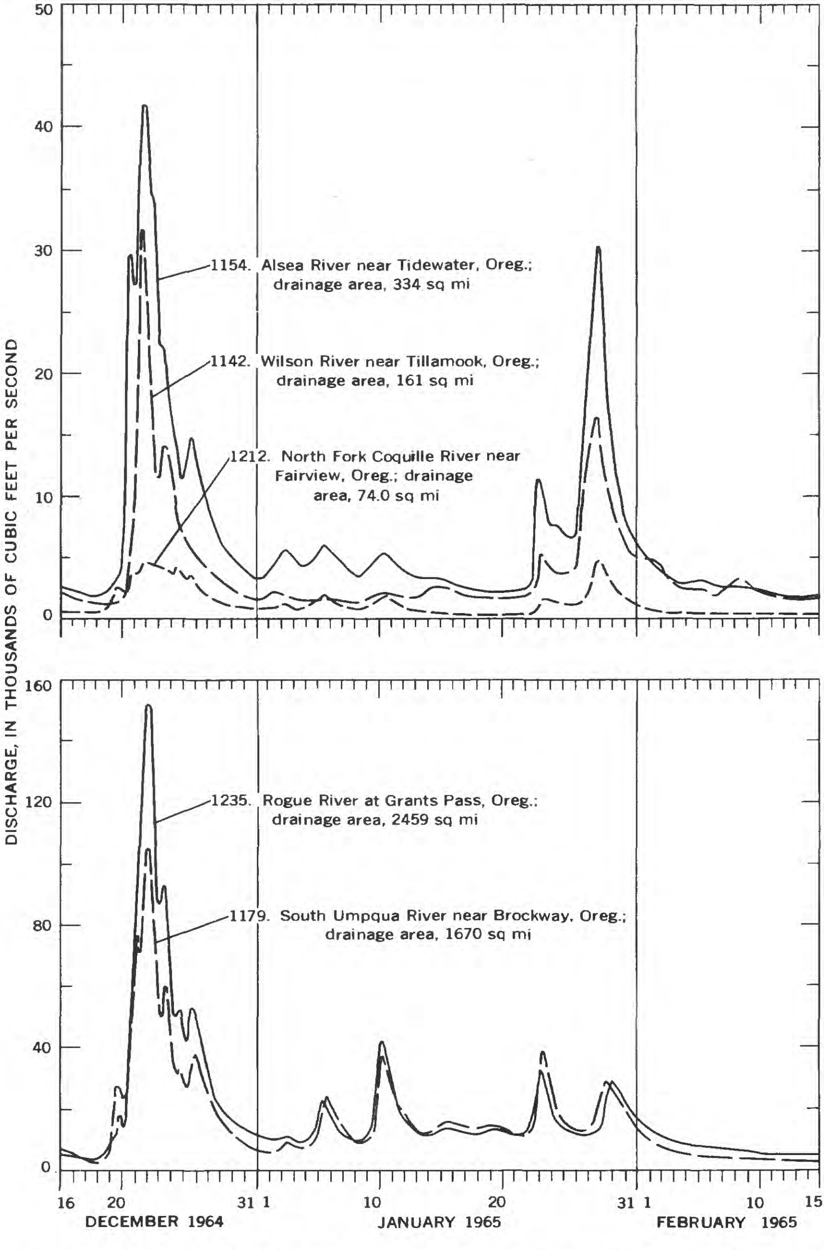

FIGURE 48.—Discharge hydrographs at selected gaging stations in coastal Oregon, December 16, 1964–February 15, 1965.

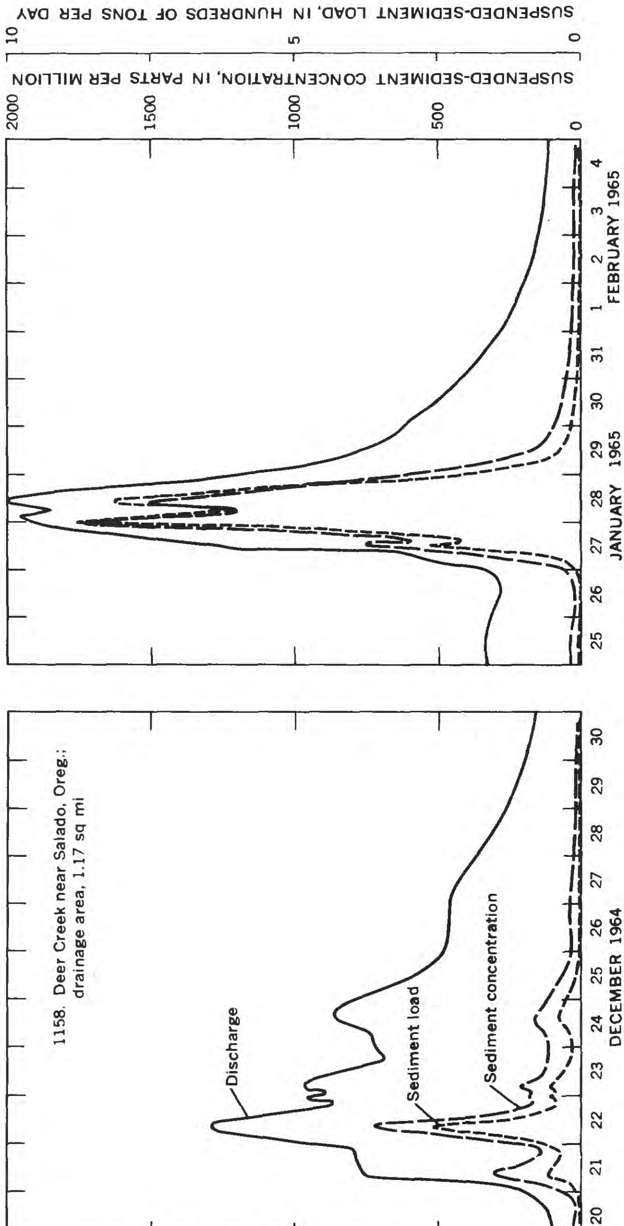

FIGURE 49.—Graphs of suspended-sediment concentration and load and stream discharge in Deer Creek near Salado, Oreg., December 20–30, 1964, and January 25–February 4, 1965.

in Umpqua River near Elkton (site 1199), for example, was 122 percent of that in 1955, and 1.2 times that for a 50-year flood. Similarly, the flow of 152,000 cfs December 23 in Rogue River at Grants Pass (site 1235) was 113 percent of that in 1955 and 1.2 times the 50-year flood, but probably was exceeded by the floods of 1861 and 1890.

Precipitation December 19–23 averaged 6–11 inches in the region; 8.2 inches fell at Newport on the central coast, and 7.5 inches at Roseburg, 50 miles inland in the Umpqua River basin. In contrast to the regional average, a total precipitation of 21.2 inches was observed at Illahe, in the Rogue River basin, and 17.9 inches at Valsetz, high in the central Coast Range. The annual precipitation at Valsetz averages more than 100 inches. The December flood depths in the lower reaches of most coastal streams were increased by backwater from high tides.

In January severe flooding was restricted primarily to small streams in the central-coastal area. Precipitation during the January 21–31 storm (fig. 4) was 21.4 inches at Valsetz, 15.0 inches at Newport, and 2.1 inches at Roseburg. The resulting peak discharges on several of the smaller streams reached the magnitudes of 50-year floods, but the floodflows generally were equivalent to those of floods having 10- to 20-year recurrence intervals.

Six lives were lost in coastal Oregon as a result of the floods. The flood losses of more than $60 million consisted largely of damage from inundation of agricultural land, erosion, deposition of sediment and debris, and inundation of towns and destruction of many buildings.

The discharge hydrographs at selected gaging stations in coastal Oregon, shown in figure 48, indicate the magnitude of floodflows for the period December 16–February 15. The graphs of suspended-sediment concentration and load and stream discharge in Deer Creek near Salado for the periods December 20–30, 1964, and January 25–February 4, 1965, are shown in figure 49 and illustrate the relation between sediment transport and streamflow during the principal flood events.

NORTH-COASTAL STREAMS

Coastal streams in Oregon north of the Umpqua River had moderately to extremely high flows during the late December floods. Record-high peaks occurred in the Wilson, Nestucca, and Alsea Rivers. The peak discharge of 32,100 cfs December 22 in Wilson River near Tillamook (site 1142) was the highest in 37 years of record. Overflows from the Wilson and Trask Rivers, increased by backwater from extremely high tides, inundated about 10,000 acres of farm and grazing land in the Tillamook area. Floodwater blocked U.S. Highway 101 and overtopped the levees and dikes in and around Tillamook. Flooding from the Nehalem, Kilchis, and Miami Rivers blocked many other roads and inundated more farmland north of Tillamook. Nearly 24,000 acres of agricultural land in the coastal stream basins was flooded, and the flood losses of nearly $5.2 million consisted largely of agricultural, commercial, and industrial damage.

The peak discharge of 40,400 cfs December 23 in Nehalem River near Foss (site 1140) was 93 percent of that in January 1964, the maximum of 35 years of record. The peak discharge of 29,800 cfs December 22 in Siletz River at Siletz (site 1150) has been exceeded at least eight times since 1906, the last time being in 1949; however, several houses were washed away near Kernville by the December flood. In the Yaquina River basin the high flows washed away a loading dock, and the high stages resulting from floodflows and high tides nearly topped the wharf decks along the Newport waterfront.

The peak discharge of 41,800 cfs December 22 in the Alsea River near Tidewater (site 1154) was the highest in 36 years of record at this site. Boathouses, residences, and docks suffered most of the damage along the Alsea River. Discharges in the small coastal basins generally were not unusually high during the late December flood.

The late January storm caused extreme floodflows in the lower Alsea and Nestucca River basins and on many small coastal streams. Sediment transport by streams in this area was particularly outstanding. In January 1965 the combined sediment load of three small streams in the Alsea River basin—Needle Branch near Salado (site 1156), Flynn Creek near Salado (site 1157), and Deer Creek near Salado (site 1158)—where comprehensive records are obtained, totaled 1,700 tons from a combined drainage area of 2.22 square miles, more than 90 percent of the total suspended load for the entire 6-year period 159–64. The graphs of suspended-sediment concentration and load and stream discharge in Deer Creek near Salado for the periods December 20–30 and January 25–February 4 are shown in figure 49.

The peak discharge of 24,000 cfs January 28 in Nestucca River near Beaver (site 1145) was 1.2 times the magnitude of the 50-year flood. Peak discharges of 609 cfs January 27 in Mill Creek near Toledo (site 1151) and 32,200 cfs January 28 in Siletz River at Siletz (site 1150) exceeded those in December. The high flows in the Siletz River swept away several homes, barns, and trailer houses, and downstream at Florence the river water was 14 inches deep in some streets. The suspended-sediment load observed in the Siletz River at Siletz 5 hours after the flood peak was equivalent to 102,000 tons per day at a concentration of 1,260 ppm. Similar observations near the flood peak in Yachats River near Yachats (site 1161) indicated a suspended-sediment load of 21,200 tons per day at a concentration of 1,450 ppm. Other coastal streams also carried large quantities of sediment for short periods of time near the flood peaks.

In the coastal area from Tillamook Head on the north to the Umpqua River on the south, most of the small streams having drainage areas less than 20 square miles had record-high discharge January 27 or 28. Pumping stations north and east of Newport near Taft, Nelscott, Delake, and Toledo were flooded, and water mains were broken, causing water shortages in these communities.

Mud slides caused by the heavy rains in late January paralyzed many communities by damaging and blocking roads, damaging homes, and cutting off water supplies. A wall of mud and debris loosened from a nearby mountain crashed down on the logging community of Mapleton in the Siuslaw River basin and caused severe damage. Several homes slid down a hillside at Toledo in the Yaquina River basin, and the nearby communities of Eddyville and Elk City were isolated by landslides. U.S. Highway 101 was blocked by landslides near Sea Lion Cave. A large earthslide February 1 along the Wilson River 7 miles east of Tillamook dammed the river, but the water eroded a channel over the earthslide.

The discharge hydrographs for stations on Wilson River near Tillamook and Alsea River near Tidewater for the period December 16–February 15 are shown in figure 48.

UMPQUA RIVER BASIN

Peak discharges on all major streams in the Umpqua River basin in late December equaled or exceeded those of floods having recurrence intervals of 50 years. The peak discharge of 60,200 cfs December 22 in South Umpqua River at Tiller (site 1167) was the highest in 27 years of record and 1.5 times the magnitude of a 50-year flood. Downstream at Brockway (site 1179), the South Umpqua River reached a peak discharge of 105,000 cfs December 23, only 65 percent of the maximum flow in 1890, but still equivalent to that of a 50-year flood. The discharge hydrograph for this station is included in figure 48. In Cow Creek, the principal tributary to the South Umpqua River, the peak discharge of 8,430 cfs December

22 at the upstream station near Azalea (site 1171) was 142 percent of the maximum flow in 1950 and 1.1 times the magnitude of a 50-year flood. However, near the mouth of Cow Creek, at the gaging station near Riddle (site 1173), the peak discharge of 37,500 cfs was only 91 percent of the maximum flow in 1950, and its recurrence interval was 12 years.

In the Roseburg area, combined floodwaters from the South Umpqua River, Deer Creek, and smaller tributaries inundated much of the west side of the city. Nearly 300 families were evacuated. Many homes were severely damaged by floating debris. Hundreds of acres of farm and orchard land upstream from Roseburg also were severely damaged by floodwater and deposition of debris.

Floodflows in North Umpqua River near Toketee Falls (site 1183) reached a record flow of 4,680 cfs December 23, which is 2.9 times the magnitude of a 50-year flood. Downstream at the station at Winchester (site 1196), near the mouth of the river, the peak discharge of 119,000 cfs December 22 was nearly 1.5 times the 50-year flood. The raging floodwaters washed out many sections of State Highway 138 and damaged several fish hatcheries and hydroelectric plants.

FIGURE 50.—Flooding at Reedsport, Oreg., December 23, 1964. Photograph by Phil Grenon, Eugene Register-Guard, Eugene, Oreg.

On the main Umpqua River near Elkton (site 1199) the flood crest December 23 was almost 6 feet higher than that in 1955, and the peak discharge was 265,000 cfs, 120 percent of that in 1955.

The December flood damage in the Umpqua River basin was extremely severe. Five lives were lost, and the damage was about $29 million. Five gaging stations were destroyed. About 24,400 acres of agricultural land was inundated. The town of Umpqua was isolated for several days. Floodwater topped the dikes at the river mouth near Reedsport (fig. 50) and water was 4 feet deep in much of the town and reached the eaves of many stores.

The January storms caused only minor floods in the Umpuqa River basin.

COOS RIVER AND COQUILLE RIVER BASINS

Heavy rains December 19–23 produced outstanding floods in the Coos and Coquille Rivers, which drain the west slope of the Coast Range and are the principal streams in Coos County. Precipitation was 13.21 inches at Powers on the South Fork Coquille River and 8.06 inches at North Bend at Coos Bay. In the Coos River basin the peak discharge of 5,560 cfs December 22 in West Fork Millicoma River near Allegany (site 1206) was only 69 percent of that in 1960. Peak discharges at all gaging stations on the South Fork Coquille River were of record magnitude and were about 1.2 times those for the 50-year floods. The maximum stage of the Coquille River at Coquille, which was affected by a high tide, was 2.5 feet above flood stage, almost identical to that in 1955; and the stage remained above flood level for about 5 days. In the North Fork Coquille River, the peak discharges at gaging stations exceeded the peaks of record and were nearly equivalent to the 50-year flood in the lower part of the basin but were less than the equivalent of the 10-year floods in the upper part of the basin.

The floods of late January were not widespread in the Coos and Coquille River basins, although peak discharges in the upper North Fork Coquille River basin and in small coastal streams exceeded those in December. The discharge hydrograph for North Fork Coquille River near Fairview is shown in figure 48.

Flood damage in the Coos River and Coquille River basins was limited largely to agricultural land and industrial property and resulted primarily from the December flood. Logjams on the South Fork and North Fork Coquille Rivers caused flooding of agricultural land. Two logging bridges were destroyed, and the sewage-treatment plant at Myrtle Point was flooded. In the lower part of the Coquille River basin, two large plywood plants were inundated

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to depths of 4–5 feet. Many homes and pastures were severely damaged by prolonged inundation and deposits of sediment. Erosion of road embankments and deposition of sediment and debris caused traffic obstructions on many roads for long periods. About 17,600 acres of agricultural land was inundated in the Coquille River basin. Tide boxes at the mouths of sloughs and tide gates in levees—one-way gates that let fresh water out but prevent tidal inflow and thus provide drainage—at Coos Bay were badly damaged, and large sediment deposits restricted shipping and dockside loading. No flood-control dams have been built in the Coquille River basin, and flood-control structures are limited to levees and tide boxes along the main stem. The levees are low and were overtopped early in the flood. Damage was about $3.1 million in the Coquille River basin and $1.2 million in the Coos River basin.

ROGUE RIVER BASIN

Heavy rains and melting snow in December caused floods in the Rogue River basin that generally far exceeded those of 1955 and rivaled those of 1890, but probably did not exceed those of 1861. The addition of 18 inches of snow December 19–21 increased the snowpack to 90 inches at Crater Lake, at an altitude of 6,475 feet above mean sea level. December 22 the freezing level rose rapidly to 10,000 feet, and heavy precipitation fell as rain. At Grants Pass 8.95 inches of rain fell December 19–23. Comparable or greater precipitation occurred during this period throughout the Rogue River basin from Medford to Gold Beach.

At the gaging station on Rogue River below South Fork, near Prospect (site 1221), where records have been collected since 1928, the peak discharge of 55,000 cfs December 22 was 170 percent of the previous maximum in December 1955, and 150 percent of the 50-year flood. As in 1955, the highest runoff was in the Illinois River basin, where the rate generally exceeded 200 cfs per sq mi. Downstream from the mouth of the Illinois River, the discharge of Rogue River was about 500,000 cfs; in December 1955 it was 414,000 cfs. The meager historical data available indicate that the December 1964 peak discharge for this lower reach of the Rogue River far exceeded that of 1890 and may have closely approached that of the 1861 flood.

The sediment loads of streams in the Rogue River basin were also extremely heavy during the December flood period; however, records were not obtained at any sites in the basin. Records of turbidity at the Grants Pass water-treatment plant indicated turbidities as high as 5,000 ppm (Columbia Basin Inter-Agency Committee, 1965, p. 88) near the flood peak.

The rampaging floodwaters that swept through the Rogue River valley caused damages of $25 million. At the communities of Shady Cove and Trail, over 200 homes, cabins, and trailer houses were washed away. Powerlines and gaslines were severed, and about 6,000 people were left without service in Medford, Ashland, Phoenix, Central Point, and Jacksonville. Many bridges over the Rogue River and its tributaries were destroyed or severely damaged (fig. 51). at Agness a county bridge, normally about 90 feet above low water, was completely destroyed by flood waters that reached heights of about 100 feet above low water at that point. About 18,800 acres of orchard, cropland, and other agricultural land was inundated. Erosion caused serious damage throughout the entire middle part of the Rogue River valley, and many homes were inundated in that area. Floodwater blocked U.S. Highway 99 and Interstate Highway 5. Many summer homes along the lower part of the river were swept away.

FIGURE 51.—Dodge Bridge near Eagle Point, Oreg., partly destroyed by the rampaging Rogue River, December 23, 1964. Columnar structure encircled by the river on the right is a Geological Survey gaging station. Photograph, courtesy Kenn Knackstedt, Medford, Oreg.

Storage in Emigrant Reservoir reduced flood stages in Bear Creek at Medford, but had only a slight effect in reducing flows in the Rogue River downstream from Bear Creek.

The January storms caused only minor floods in the Rogue River basin. The discharge hydrograph for Rogue River at Grants Pass is included in figure 48.

OTHER COASTAL BASINS

Severe flooding occurred in many streams in the south coastal area as a result of the late December storm. U.S. Highway 101 over the Chetco River at Brookings was declared unsafe, and a break occurred in the dike protecting the dock area of the city. Damage in the Chetco River basin was about $673,000.

MINOR AREA OF FLOODING IN WASHINGTON

Severe flooding occurred in late January in the upper White River and Green River basins in Washington as a result of the January 21–31 storm, but reservoirs were effective in reducing peak discharges downstream. The location of this area, which is in King and Pierce Counties and is centered about 25 miles north of Mount Rainier and 30 miles east of Tacoma, is shown in figure 1. The location of flood-data sites 612 to 625 is shown in figure 30.

Precipitation was moderately heavy in south-central and western Washington during the December 19–23 and January 21–31 storms, but flooding generally was not outstanding. In the White River and Green River basins, however, the precipitation in late January was heavy; 13.4 inches was observed at Greenwater, in the middle of the area (fig. 4). The storm culminated in heavy rain January 27–29 that produced high runoff. The peak discharge of 5,090 cfs January 29 in Greenwater River at Greenwater (site 615) was about 95 percent of the maximum flow in a 36-year record, 1.6 times that for a 50-year flood, and was representative of the major runoff in the upper White River basin. The magnitudes of flows in several other tributary streams in the area also exceeded those for 50-year floods. However, owing to storage in Mud Mountain Reservoir, operated for flood control, the peak discharge downstream in the White River near Buckley (site 620) was only 11,200 cfs January 30, equivalent to less than that for a 3-year flood. The reservoir contents reached a high of 44,130 acre-feet January 31 (site 619), the maximum of record. Peak discharges in the Green River were reduced by storage in Howard Hanson Reservoir.

Flood damage was most severe in the Scatter Creek basin, a tributary of the White River, and included destruction of a bridge on U.S. Highway 410 near Enumclaw. In Cyclone Creek, another White River tributary, the floodflows rolled huge boulders, some as large as an automobile, down the channel.

SEDIMENTATION

The processes of sedimentation, which are principal agents in the shaping of the earth's surface, are greatly accelerated during major flood events such as described herein. Because of their major role, much of the damage associated with floods is caused directly by, or can be related to, one or several of the sedimentation processes—weathering, erosion, transportation, deposition, and diagenesis or consolidation into rock. Erosion, transportation, and deposition were the principal sedimentation processes during the floods. Other phenomena such as slides and slumps were closely associated with flooding and contributed large quantities of sediment to the sedimentation process. This contribution was particularly large in parts of the basins of the Eel, Mad, Klamath, and Smith Rivers of northern California and the basins of the Willamette, Siuslaw, and Wilson Rivers of western Oregon, where the topographic relief is steep and the surface formations are poorly consolidated.

A comprehensive description of the meteorologic events during December 1964 and January 1965 that led to the exceptionally high runoff and set up the extreme erosion potential is given in the section on the storms. In northern and central California and in western Nevada, the erosion conditions were attributable primarily to the unusually high runoff from heavy, intense rains that fell December 19–23 on previously saturated soils. In large areas in Oregon, Washington, and Idaho, the saturated soils had frozen to a depth of several inches prior to the heavy precipitation that triggered the December flood. During the early part of the storm almost the entire three-state area had been covered with a thick blanket of snow. The heavy rains were at first absorbed by the snow and later released as the snow melted; thus runoff was augmented. The slowly thawing soils prevented normal infiltration and ensured large quantities of surface runoff, but provided little protection from erosion. Similar conditions occurred again in late January in parts of Oregon, Washington, and Idaho.

Erosion was most severe in areas that had steep slopes and sparse vegetation. Many cultivated farmlands on steep slopes, planted in winter wheat or lying fallow, were stripped of the top layer of soil and cut by deep gullies. Quantitative data on erosion are meager; however, some data on sheet and rill erosion of farmlands in southeastern Washington are available. Winter wheatfields in

Whitman County, northeast of the area of greatest erosion, lost as much as 50 tons of soil per acre during 1964–65 (Columbia Basin Inter-Agency Committee, 1965, p. 10–14).

Deposition of sediment occurred throughout the flood area. As streams receded from their flood peaks and their velocities decreased, deposits of sediment several feet thick were left in places on the flood plains (fig. 52) and highways and in houses that had been inundated. The largest deposits occurred near the mouths of streams, particularly those that were backed up by high tides or by high stages in confluent streams. Sediment deposition on broad flood plains behind channel obstructions of various types was heavy, and thick layers of sediment were left in some low-lying areas where temporary lakes had been formed. Lakes and reservoirs trapped much sediment and reduced downstream sediment loads, but the storage capacity of the lakes and reservoirs also was re-

FIGURE 52.—Sediment, several feet deep, left by receding Trinity River floodwaters near Hoopa, Calif., December 1964. Photograph by George Porterfield, Water Resources Division, U.S. Geological Survey.

duced. Large deposits of coarse sediment at the mouths of tributary channels having steep gradients were common throughout the area; the deposits were notably large in north-central Oregon. Many of these channels, which are usually dry, delivered rock material too large for transport by the principal rivers. This coarse material formed deltas and contributed to the formation of gravel bars in the major rivers. The reduction of channel capacity by this means was often a cause of flooding. Considerable erosion of cultivated lands on flood plains occurred also when streams overtopped their banks or changed their courses. However, in many parts of the flood area much of the sediment transported by the streams was derived from the beds and banks of the streams as channels were scoured and widened to adjust for the increased flow. Severe bank caving occurred in most streams when their banks were undercut. This caving was especially damaging to the embankments of highways and railroads that closely paralleled the streams and to many buildings on or near streambanks (figs. 21, 22, 37, 38).

The quantity of sediment eroded from source areas and that deposited by the floods are unknown; however, the magnitudes may be inferred from the quantity of sediment transported by rivers in the flood area. Some data on sediment transport during the flood period are available and can be related to erosion and deposition generally; consequently, this discussion is primarily about the transportation process.

Whereas sediment transport was above normal for most streams in the flood area for the entire period December 1964–February 1965, the rate of transport was greatly accelerated during short periods near the time of the peak discharge of the two major floods. Sediment transport during flood periods is closely associated with runoff from the drainage basin; therefore, the areas of greatest sedimentation activity during the two major floods closely coincide with the flood areas outlined in figure 1. Sediment transport during the short period near the December flood crest was particularly outstanding for most streams. For example, the suspended-sediment load of the Eel River at Scotia, Calif. (site 514), was estimated to be 57 million tons December 23 and 140 million tons (about 70 tons per acre of drainage area) December 19–27; the computed suspended-sediment load of the John Day River at McDonald Ferry, Oreg. (site 926), was 9 million tons (2 tons per acre) December 21–26, and that of the Walla Walla River near Touchet, Wash. (site 874), was 6 million tons (6 tons per acre) December 22–25. One million tons of sediment deposited on an average city block would be approximately 80 feet deep. The magnitudes of short-term sediment loads in some small streams draining the loess soils of farmlands in southeastern Washington were extremely large. During the December flood the maximum instantaneous sediment load in Dry Creek at Lowden, Wash. (drainage area, 245 sq mi), for example, was more than twice that for the Columbia River at Vancouver; and observed suspended-sediment concentrations in several streams in southeastern Washington exceeded 300,000 ppm (30 percent of the discharge by weight).

Sedimentation data for historical floods are sparse, and few data are available for comparison; however, on the basis of the streamflow records, the disastrous erosion, and the extensive sediment deposition, the floods of December 1964 were outstanding sedimentation events, in both the magnitude of the sediment transported and the broad areal extent. The maximum suspended-sediment concentrations for the December 1964 flood ranged from slightly less than those in 1963 in parts of the San Joaquin River and Sacramento River basins in California to nearly 10 times the maximum concentrations in 1963 in the Willamette River at Portland, Oreg. Under normal conditions the sediment loads measured at the mouth of the Walla Walla River near Touchet, Wash., are large because of the large expanse of readily erodible loess soils in the drainage basin. The sediment loads at this site in December 1964 and January 1965 were particularly outstanding; the load December 22–25 was more than five times that of February 3–5, 1963, the previous maximum load observed, and the sediment load for January 27–February 3, 1965, was twice the 1963 load.

The section "General description of floods" included discussion of the sediment loads and transport in many stream basins. Data on sediment concentration and load in the flood area are summarized in table 20; detailed information, with the results of some particle-size analyses, are included in the presentation of station data in Part 2, Streamflow and sediment data, of this report in Water-Supply Paper 1866–B.

Much of the damage in the flood area was the result of, or can be related to, sedimentation. The general flood damage and associated monetary losses are summarized in a separate section of this report. A discussion of some of the more noteworthy aspects and incidents of the sedimentation damage follows.

Erosion of highway and railroad embankments and bridge approaches caused widespread damage and obstructed traffic during and immediately after the flood. Floating debris and sediment clogged channels and reduced flow capacity at many bridge openings; at others the great floodflows simply exceeded the channel capacities. Floodwaters forced out of the stream channels flowed around bridges and eroded bridge approaches, streambanks, and road embankments. This overflow and erosion occurred in all parts of the flood area, but was especially severe in northern California where the extreme flows and erosion greatly widened channels and left bridges as small islands or peninsulas in the streams. Some bridges were lost or damaged when abutments or piers were undermined by scour of the streambeds. The John Day River bridge on Interstate Highway 80N in Oregon (fig. 37) was damaged by collapse of two spans of the bridge. Mudflows, slides, and sediment deposits on roadways obstructed traffic at many places. Traffic problems were particularly severe in southeastern Washington and northeastern Oregon owing to large sediment deposits on roadways.

Several massive landslides caused major problems of local flooding and damage and contributed large volumes of sediment to streams. A landslide in December in California along the Salmon River, tributary to the Klamath River, was composed of 2–3 million cubic yards of material; it impounded water for several hours to an unknown depth. Water subsequently released from the temporary impoundment, combined with Klamath River floodflows, created record stages and flows at the confluence of the two streams at Somesbar. In the Smith River basin in California numerous landslides and washouts in December, notably in the canyon reach of the Middle Fork Smith River, and extreme streambank erosion produced large volumes of sediment. A landslide more than 2 miles long and as wide as 700 feet near the Bear Basin Butte, 11 miles east of Gasquet, destroyed more than 7 million board feet of timber and produced heavy sediment and debris loads (fig. 53). A 45-acre landslide occurred also at the forks of South Fork Smith River and Harrington Creek 17 miles southeast of Gasquet. A large earthslide February 1, along the Wilson River 7 miles east of Tillamook, in coastal Oregon, dammed the river and created a large lake. Fear of downstream damage from a sudden release of the ponded water was alleviated when the water eroded a channel over the slide material and the water level was gradually lowered.

Damage to farmland and buildings from erosion and deposition was severe throughout the flood area, particularly in southeastern Washington, west of the Cascade Range in Oregon, and in northern California. In Whitman County, Wash., almost 16 million tons of soil was lost from winter wheatfields (Columbia Basin Inter-Agency Committee, 1965, p. 10). Much of the sediment eroded from farmland was deposited in roadside ditches, on roads, on flood plains, on streets, and in buildings. Sediment several feet thick was deposited

FIGURE 53.—Landslide in Middle Fork Smith River basin near Bear Basin Butte, 11 miles east of Gasquet, Calif. The slide, more than 2 miles long and as wide as 700 feet, destroyed 7 million board feet of virgin timber. Photograph courtesy of U.S. Forest Service.

in many buildings on flood plains, particularly in the downstream reaches of streams. Erosion around foundations of buildings adjacent to streams caused much damage. In many instances, entire buildings were demolished or washed away as a result of undermined foundations or the caving of streambanks.

Municipal facilities were severely damaged by erosion, transport, and deposition of sediment. Water and sewerlines in many communities were exposed by erosion or completely washed out. The grounds and access roads to water-supply and waste-treatment plants were eroded in many towns. Many water and sewerlines and diversion structures, as well as drainageways in some cities and towns, were filled with sediment and debris. At Rufus, Oreg., flows from a usually dry gully deposited large boulders and gravel over much of the town. Cottonwood Creek near Boise, Idaho, transported an estimated 120,000–150,000 cubic yards of sediment (Columbia Basin Inter-Agency Committee, 1965, p. 80), much of which filled a drainageway or was deposited on the city streets. In some instances, the scouring of streambeds may have had a beneficial effect through removal of organic matter which caused high oxygen demand. Turbidities were high in the surface-water supplies of cities in the flood area, and because many of the cities could not treat their supplies, the high turbidities continued for several days. The turbidity of the Rogue River at the Grants Pass, Oreg., water-treatment plant, for example, reached 5,000 ppm (Columbia Basin Inter-Agency Committee, 1965, p. 88) in December and required flocculation before filtration treatment. Deposition of sediment in municipal water-supply reservoirs was a major problem in the flood area. Sediment deposits reached 11-foot depths in the Corvallis, Oreg., water-supply reservoir on North Fork Rock Creek and were estimated to occupy 7,500 cubic yards of space with resultant reduction in the storage capacity from 4.5–3.0 million gallons (Columbia Basin Inter-Agency Committee, 1965, p. 89).

Sedimentation damage to fisheries was widespread. The eggs and fry of salmon and other fish were scoured from the gravel beds in some reaches of streams or were smothered by a thick blanket of fine sediment in others. In some reaches, however, the reworking of the gravels may have had a beneficial future effect on fish-spawning areas because the porosity of the gravel was improved by removal of fine material. Sediment deposition in fish hatchery ponds throughout the flood area was a major factor in the loss of fish production.

Erosion and deposition of sediment caused much damage to recreation facilities, particularly campgrounds and picnic areas adjacent to stream channels. Campgrounds and access roads were badly damaged by erosion or deep deposits of sediment. Many campgrounds were completely devastated by the floods, and sediment was deposited to depths of several feet in buildings that had been inundated by the floods. In mountainous areas many trails were heavily damaged by erosion. Flood-caused turbidity was detrimental to sports-fishing activities for many months.

Water storage, diversion, and other development works were affected by the high flows and by sedimentation. Records of sediment accumulations in reservoirs are meager, but the data on sediment loads transported indicated that the accumulations were high. Construction at some dams was hampered by erosion and deposition in the construction area, as at lower Monumental Dam on the Snake River and at Green Peter Dam on the Middle Santiam River, where cofferdams and other facilities were damaged by overtopping, erosion, and debris accumulation. Sediment also plugged the large bypass tunnels at the Oroville dam on the Feather River in California.

In addition to the effects noted above, other flood-related problems became apparent after the flood. The formation of large gravel bars in stream channels reduced the capacity of many streams, and fine sediment deposits on flood plains provided material for duststorms. The channels of streams affected by erosion and sediment deposition remained unstable for long periods as a result of sediment transport and successive and repeated aggradation and degradation. Sediment eroded from the upstream reaches is still accumulating (1968) in the lower reaches of some rivers. For example, in most coastal streams in northern California, there was appreciable streambed aggradation in downstream reaches during the 3 years following the floods as winter runoff brought in sediment that had been deposited in upstream reaches during the floods.

FLOOD DAMAGE

The floods of December 1964 and January 1965 were by far the most damaging in the history of the area. Forty-seven deaths were attributed to the storms or floods in December—24 in north-coastal California, 21 in Oregon, and 2 in Idaho. Total damage was more than $430 million, more than twice that during the devastating floods of December 1955; about two-thirds of this amount occurred in the coastal basins in California and Oregon and in the Willamette River basin in Oregon. Most of the damage resulted from the widespread storms and floods of December 1964, but extensive damage was caused in Oregon, southeastern Washington, and Idaho by the severe floods of late January 1965.

The large monetary losses caused by the floods resulted in large part from destruction of communities, industrial plants, roads and bridges, and various public facilities; however, agricultural, residential, and commercial losses also were very large, and the disruption of normal business and industrial activities caused substantial loss of income. Numerous storage reservoirs and flood-control facilities provided substantial control of floodwaters in many basins and prevented much greater damage.

Surveys of storm and flood damage were made by the Corps of Engineers, Soil Conservation Service, Forest Service, and many other Federal, State, county, and service and private organizations. The Corps of Engineers assembled all available damage reports made by other agencies, as well as reports of interviews with many property owners, local organizations, public utilities, and private firms. Flood damage for each of the principal hydrologic regions is summarized in the sections that follow.

THE GREAT BASIN

Flood damage in the Great Basin part of the flood-affected area totaled nearly $7 million. About $2.5 million of this amount occurred in California and Nevada in nearly the same area that had suffered about $4 million in flood damage during the floods of December 1955 and January 1956. Damage in Reno and Sparks, Nev., was $237,000, about a fourth of that in 1955. Agricultural activities and transportation facilities suffered the bulk of the nearly $4.4 million flood damage in the Oregon part of the Great Basin. There were no deaths in the Great Basin attributable to the floods.

Flood damage in California and Nevada is summarized, under five categories by stream basins and river reaches, in table 2. The flood damage in the Oregon part of the basin is summarized, under eight categories by stream basins, in table 3.

SAN JOAQUIN RIVER AND SACRAMENTO RIVER BASINS

The flood of December 1964 caused widespread damage in the northern San Joaquin River and the Sacramento River basins in California. Flood damage totaled $43.7 million, 46 percent of that experienced in these two basins during the floods of December 1955–January 1956, and included more than $9 million damage to forest and park facilities in mountainous areas (as reported by the Forest Service and the National Park Service). About 50 percent of the total damage occurred in the valley-floor areas, but was limited to a few areas by the effectiveness of existing flood-control projects and conservation reservoirs. The flood of early January 1965 caused relatively minor damage. There was no loss of life in the San Joaquin River and Sacramento River basins attributable to the flood.

TABLE 2.—*Flooded areas and flood damage in the Great Basin, California and Nevada, December 1964 and January 1965*

[Compiled by U.S. Army Corps of Engineers, Sacramento District]

Stream basin and reach	Flooded area (acres)	Flood damage (thousands of dollars)					
		Agricultural	Residential	Commercial	Industrial and utilities	Public facilities	Total
Carson River basin:							
East Fork above Watasheamu damsite	0	0	0	0	0	5	5
East Fork below Watasheamu damsite	100	0	10	0	0	54	64
West Fork to Centerville	400	11	0	0	0	12	23
East and West Forks, Centerville to Carson gage	10, 000	44	0	0	0	223	267
Main Carson River, Carson gage to Lahontan Reservoir	3, 000	11	0	0	0	260	271
Main Carson River below Lahontan Reservoir	0	0	0	0	0	0	0
Total	13, 500	66	10	0	0	554	630
Truckee River basin:							
Streams tributary to Lake Tahoe:							
Upper Truckee River	800	0	0	0	0	50	50
Blackwood Creek	360	0	45	0	0	10	55
Miscellaneous creeks	0	0	0	0	0	55	55
Prosser Creek and Little Truckee River	0	0	0	0	0	78	78
Truckee River, main stem:							
Lake Tahoe to Martis Creek	20	0	0	5	17	4	26
Martis Creek to Reno	30	11	2	5	9	0	27
Reno and Sparks	0	0	0	0	0	237	237
Sparks to Vista	2, 400	175	0	15	11	87	288
Vista to Derby Dam	500	17	0	0	11	74	102
Derby Dam to Pyramid Lake	1, 200	12	0	0	110	566	688
Total	5, 310	215	47	25	158	1, 161	1, 606
Susan River basin:							
Susan River	13, 200	65	3	2	0	0	70
Gold Run Creek	1, 100	43	0	0	0	0	43
Total	14, 300	108	3	2	0	0	113
Streams tributary to Surprise Valley:							
Miscellaneous creeks (43)	2, 000	108	1	1	0	81	191
Grand Total	35, 110	497	61	28	158	1, 796	2, 540

TABLE 3.—*Flood damage in the Great Basin in Oregon, December 1964 and January 1965*

[Compiled by U.S. Army Corps of Engineers, Portland District]

Stream basin	Flood damage (thousands of dollars)								
	Agricultural	Residential	Commercial and industrial	Transportation	Utilities	Public facilities	Channel improvements and control structures	Emergency relief	Total
Warner Lakes basin:									
Warner Valley	310			210			61	1	582
Abert Lake basin:									
Chewaucan River	940	34	30	1, 136	5		192	5	2, 342
Silver Lake basin:									
Silver Creek	62						12		74
Malheur and Harney Lakes basin:									
Silvies River	1, 226	46	45	32		4		8	1, 361
Grand total	2, 538	80	75	1, 378	5	4	265	14	4, 359

Damage in excess of $4 million each occurred in the Feather River, Yuba River, and American River basins and in the Sacramento River basin upstream from Shasta Dam. In the Feather River basin the flood damages in the headwater areas and upstream from construction on the Feather River, effected some detention of floodwaters and reduced peak flows and damage downstream, but the contractor sustained moderately heavy damage to his equipment. The breaching of the partly built Hell Hole Dam on the Rubicon River in the American River basin increased downstream flood damage and added to the construction costs of the dam and appurtenant facilities.

A summary of flood damage under five categories by stream basins in the San Joaquin River and Sacramento River basins is presented in table 4.

NORTH-COASTAL CALIFORNIA

Twenty-four lives were lost in north-coastal California as a result of the catastrophic floods of December 1964, and flood damage totaled more than $195 million. The Eel River and the Klamath River basins were the hardest hit, having flood damages of $81.6 and $71.6 million, respectively. The towns of Klamath, Klamath Glen, Requa, Camp Klamath, Metropolitan, and Pepperwood were completely destroyed, leaving the residents homeless and many of them destitute. Major damage occurred in towns and communities such as Keno in Oregon, and Gasquet, Orick, Sawyers Bar, Orleans, Weitchpec, Hoopa, Willow Creek, Hyampom, Shively, Holmes, Weott, and Myers Flat in California. The American Red Cross reported that about 7,900 families suffered losses. In addition, approximately 2,000 homes and 400 trailers were destroyed or damaged, and about 400 small businesses were destroyed or suffered major damage. Public utility damage was severe. The forest-products industry sustained very heavy damage, including loss of standing timber, loss of logs and stockpiles of lumber, and the destruction of mills and facilities. Damage on most of the streams where flooding occurred far exceeded that for any previous flood, and the overall flood damage was 4½ times the $43 million loss in the region caused by the great floods of December 1955–January 1956.

Flood damage by stream basins is summarized under eight categories in table 5. In addition to the tremendous damage in the Eel River and the Klamath River basins, the Russian River, Mad River, and Smith River basins each suffered flood damage in excess of $7 million. Healdsburg and Guerneville in the Russian River

TABLE 4.—*Flooded areas and flood damage in the San Joaquin River and Sacramento River Basins, December 1964 and January 1965*

[Compiled by U.S. Army Corps of Engineers, Sacramento District]

Stream basin and reach	Flooded area (acres)	Flood damage (thousands of dollars)					
		Agricultural	Residential	Commercial	Industrial and utilities	Public facilities	Total
San Joaquin River basin:							
San Joaquin River	1,000	11	0	0	56	207	274
Merced County Stream group[1]	14,100	105	0	0	0	10	115
Merced River	1,900	61	0	0	520	407	988
Tuolumne River	400	17	0	0	0	110	127
Stanislaus River	11,400	977	7	2	9	713	1,708
Stockton Area Streams[2]	200	11	0	0	17	51	79
Mokelumne River	....	0	0	0	7	235	242
Cosumnes River	35,200	533	0	0	21	270	824
Morrison Creek and Snodgrass Slough	7,700	134	0	0	0	22	156
Total	71,900	1,849	7	2	630	2,025	4,513
Sacramento River basin:							
Sacramento River basin above Shasta Dam[3]	47,260	366	204	51	2,093	1,397	4,111
Sacramento River basin below Shasta Dam	43,600	1,323	140	473	49	1,620	3,605
Butte Basin	100,400	827	0	6	61	167	1,061
Redding stream group[4]	5,875	399	71	11	32	1,068	1,581
Middle Sacramento River basin tributaries, west side[5]	9,765	859	38	18	455	1,259	2,629
Middle Sacramento River basin tributaries, east side[6]	1,830	89	0	42	22	754	907
Stony Creek	3,130	94	0	0	6	542	642
Colusa basin and tributary streams[7]	8,635	82	0	0	2	124	208
Feather River	27,100	2,613	82	99	399	4,877	8,070
Yuba River[8]	4,720	254	31	51	104	5,237	5,677
Coon Creek stream group[9]	7,700	37	0	0	0	10	47
Bear River	1,750	16	0	0	149	12	177
American River	3,780	13	242	5	420	3,765	4,445
Cache Creek	16,195	520	2	0	122	803	1,447
Putah Creek	1,890	67	9	0	11	62	149
Cache Slough and tributaries	7,110	13	0	0	0	181	194
Sacramento River bypasses and ship channel	92,400	1,253	0	0	17	2,129	3,399
Sacramento-San Joaquin Delta Islands and Suisun Bay	400	10	0	0	17	848	875
Total	383,540	8,835	819	756	3,959	24,855	39,224
Grand total	455,440	10,684	826	758	4,589	26,880	43,737

[1]Includes Bear, Deadman, and Mariposa Creeks.
[2]Includes Calaveras River, Snodgrass Slough, and Littlejohn, Duck, and Bear Creeks.
[3]Includes Sacramento, McCloud, and Pit Rivers, and Forest Service areas.
[4]Includes Cottonwood, Battle, Churn, and Olney Creeks, Oregon Gulch, and miscellaneous streams.
[5]Includes Thomes and Elder Creeks, and miscellaneous creeks.
[6]Includes Big Chico, Mud, Deer, Mill, and Antelope Creeks, and Sandy Gulch.
[7]Includes Colusa Basin Drainage Canal and Willow Creek stream group.
[8]Includes Forest Service areas.
[9]Includes Coon and Pleasant Grove Creeks, Markham and Auburn Ravines, and Bunkham Slough.

TABLE 5.—*Flood damage in north-coastal California, December 1964*

[Compiled by U.S. Army Corps of Engineers, San Francisco District]

Stream basin	Flood damage (thousands of dollars)								
	Agricultural	Residential	Commercial	Industrial and utilities	Railroads	Roads and bridges	Public facilities	Public Laws 99 and 875	Total
Russian River	3,700	5,800	3,100	100	200	1,800	700	1,800	17,200
Coastal streams, including Eureka area[1]	900	....	200	700	100	1,300	300	300	3,800
Eel River	13,600	4,800	3,300	14,400	17,000	18,000	3,700	6,800	81,600
Mad River	1,300	100	300	900	....	2,400	900	1,900	7,800
Redwood Creek	300	100	400	200	....	100	100	100	1,300
Klamath River[2]	4,600	4,600	4,600	5,900	100	37,600	7,500	6,700	71,600
Smith River	2,000	600	200	200	....	5,600	1,600	2,000	12,200
Total	26,400	16,000	12,100	22,400	17,400	66,800	14,800	19,600	195,500

[1]Streams between Russian River and Eel River basins, and local streams and drainage channels at Eureka.

[2]Includes damage in Oregon part of basin.

TABLE 6.—*Flood damage in the upper Columbia River basin, December 1964 and January 1965*

[Compiled by U.S. Army Corps of Engineers, Seattle District]

Stream basin	Flood damage (thousands of dollars)							
	Agricultural	Residential	Transportation	Utilities	Commercial	Public facilities	Emergency relief	Total
Coeur d' Alene River	76	407	413	25	6	772	26	1,725
St. Joe and St. Maries Rivers	56	16	946	15	3	6	7	1,049
Yakima River	5	5	260	....	....	135	....	[1]405
Total	137	428	1,619	40	9	913	33	3,179

[1]An additional $75,000 damage in Yakima River basin estimated by Corps of Engineers, Walla Walla District.

basin were badly damaged. The damage to roads, bridges, and railroads, which was 43 percent of the total, seriously hampered flood fighting, emergency activities, and postflood rehabilitation. Substantial costs were sustained in the repair and restoration of public facilities and mitigation of public-health and safety hazards performed under Public Laws 99 and 875 by the Corps of Engineers at the request of the Office of Emergency Planning.

UPPER COLUMBIA RIVER AND SNAKE RIVER BASINS

The flood of December 1964 caused severe damage throughout much of the Snake River basin and in parts of the upper Columbia River basin; the flood of late January 1965, however, caused the greatest damage in the lower Snake River basin. Total damage in the region from the two floods was more than $20 million, of which $3 million occurred in basins tributary to the upper Columbia River. Two lives were lost in the Snake River basin in Idaho as a result of the floods in December. The most substantial damage from the December flood occurred in the Clearwater River basin and in the lower Snake River and minor tributary basins. In late January, over 36 percent of the flood damage occurred in the Grande Ronde River valley in Oregon. The principal losses in the Snake River basin consisted of damage to agricultural land and to dams and damsites. Damage at the Lower Monumental damsite on the Snake River, after a section of a cofferdam washed out, was $1.2 million. The losses in the upper Columbia River basin consisted primarily of damage to roads, bridges, and railroads and to delays and interruptions of traffic.

Flood-damage estimates for the upper Columbia River basin are summarized under seven categories by stream basins in table 6. Flood damage in the Snake River basin is summarized under eight categories by stream basins and reaches in table 7.

LOWER COLUMBIA RIVER BASIN

Flood damage occurred throughout most of the lower Columbia River basin and amounted to more than $43 million. Twelve lives were lost in Oregon in December from flood and storm-related causes. Damage in the John Day River and the Sandy River basins was particularly severe. Losses in the John Day River basin totaled more than $6 million, and about $3 million of this damage was to agricultural land and property. In the Sandy River basin residential property and stream channels received most of the damage. The greatest single loss was the failure of the recently constructed Interstate 80 Highway bridge at the mouth of the John Day River.

TABLE 7.—*Flooded areas and flood damage in the Snake River basin, December 1964 and January 1965*

[Compiled by U.S. Army Corps of Engineers, Walla Walla District]

Stream basin and reach	Flooded area (acres)	Flood damage (dollars)								
		Agricultural	Residential	Commercial and industrial	Highways, roads, streets and bridges	Railroads	Utilities	Public facilities	Emergency expenditures	Total
Portneuf River	1,476	81,300	5,000	800	60,000	42,600		41,600	32,400	263,700
Snake River and minor tributaries above Twin Falls, Idaho										631,000
Little Wood River	2,534	81,600	59,700	3,000	7,300	5,800		2,600	24,900	184,900
Big Wood River	1,175	149,700	7,500	15,400	7,500	2,700	190,500	7,800	15,500	396,600
Owyhee River[1]	7,337	336,700	1,600		9,400		700	8,500	10,400	367,300
Boise River										651,000
Malheur River		356,500			135,000	31,000	21,500		16,400	560,400
Payette River	7,095	343,800	20,000	112,900	39,300	21,200	4,800	9,500	174,100	725,600
Weiser River	4,174	191,700	11,600	2,500	24,300	2,100	100	6,300	160,500	399,100
Snake River and minor tributaries between Twin Falls, Idaho and Brownlee Dam										1,669,000
Powder River		1,015,000			6,100		22,000		4,300	1,047,400
Salmon River										1,000
Grande Ronde River	22,330	752,100	203,300	41,200	349,700	1,253,000	3,200	15,600	112,200	2,730,300
Clearwater River	299	108,100	115,100	988,800	1,408,000	238,000	54,100	126,600	154,300	3,193,000
Tucannon River	2,066	357,000	7,000	9,100	208,000	13,000	137,500	15,000	78,900	825,500
Palouse River		131,000	15,000	22,000	350,000	5,000		22,000	55,000	600,000
Lower Snake River and minor tributaries										2,954,000
Total										17,199,800

[1]Jordan Valley.

TABLE 8.—*Flood damage in the lower Columbia River basin, December 1964 and January 1965*

[Compiled by U.S. Army Corps of Engineers, Walla Walla and Portland Districts]

Stream basin and reach	Flood damage (thousands of dollars)								
	Agricultural	Residential	Commercial and industrial	Transportation	Utilities	Public facilities	Channel improvement and control structures	Emergency relief	Total
Columbia River main stem:									
Between Rufus and Bonneville, Oreg.	0	0	0	159	0	0	0	2	161
Oregon and Washington—Bonneville to Sandy River, Oreg., and Camas, Wash.	23	3	16	167	0	3	0	1	213
Washington—Camas to Lewis River	362	22	195	3	76	2	57	8	725
Oregon—Sandy River to Willamette River	56	10	385	125	0	10	31	30	647
Washington—Lewis River to Columbia River mouth	47	70	571	60	11	5	175	27	966
Oregon—Willamette River to Columbia River mouth	218	9	763	3	0	7	140	41	1,181
Total	706	114	1,930	517	87	27	403	109	3,893
Tributary basins downstream from Snake River:									
Walla Walla River	1,580	193	142	485	115	363	(1)	586	3,464
Umatilla River	1,275	408	199	1,228	10	161	(1)	447	3,728
Willow Creek	746	16	20	738	5	6	(1)	2	1,533
John Day River	3,209	159	735	1,363	61	128	(1)	386	6,041
Minor tributaries between Snake River and Rufus, Oreg.	....	....	....	....	....	....	....	....	2,827
Spanish Hollow	62	0	144	1,624	0	0	0	0	1,830
Deschutes River	441	162	687	1,828	0	451	209	201	3,979
Fifteenmile Creek	883	34	400	862	111	0	0	6	2,296
Mill Creek	217	22	55	108	48	0	0	12	462
Klickitat River	165	22	43	842	26	6	9	6	1,119
Hood River	0	0	0	1,141	895	495	697	2	3,230
White Salmon River	0	0	0	59	0	0	7	0	66
Little White Salmon River	0	0	0	0	0	60	0	0	60
Wind River	0	0	0	25	0	9	0	0	34
Sandy River	0	2,490	111	871	590	99	1,303	97	5,561
Lewis River	67	0	0	0	0	8	68	0	143
Cowlitz River	167	24	17	19	2,381	24	55	24	2,711
Minor tributaries below Rufus, Oreg.	41	0	112	0	0	49	0	0	202
Total	8,853	3,530	2,665	11,193	4,242	1,859	2,348	1,769	39,286
Grand total	[2]9,559	[2]3,644	[2]4,595	[2]11,710	[2]4,329	[2]1,886	[2]2,751	[2]1,878	43,179

[1]Not determined.

[2]Does not include damage on minor tributaries between the Snake River and Rufus, Oreg.

Flood damage, summarized under eight categories according to main-stem river reaches of the Columbia River and tributary basins, is given in table 8. The total damage in the region was distributed as follows: 27 percent, transportation facilities; 22 percent, agricultural; 10 percent, commercial and industrial; 10 percent, utilities; 8 percent, residential; and 23 percent, public facilities, channel improvement and control structures, and emergency relief.

WILLAMETTE RIVER BASIN

Flood damage in the Willamette River basin totaled $65 million, about 6½ times the total value incurred by the floods of December 1955–January 1956. Three lives were lost as a result of the December floods. About 58 percent of the damage in the basin occurred along the valley floor, whereas the heaviest monetary damage on a tributary occurred in the Clackamas River basin and amounted to 11 percent of the total for the Willamette River basin. The extensive flood-control facilities in the basin, including reservoirs and bank-protection works, were effective in preventing much greater flood damages in the Willamette Valley. The encroachment of housing developments on the flood plain, however, contributed greatly to an increase in residential losses over those resulting from the December 1955–January 1956 flood. Commercial and industrial property along the main stem of the Willamette River near Oregon City and Portland suffered about 28 percent of the damage. Floating logs and debris from upstream sources were one of the principal causes of damage in the lower valley, where they piled up against bridges and demolished riverside facilities. Damage to agriculture (primarily from erosion of crop and pasture land in the middle valley) and damage to transportation facilities were 26 and 20 percent, respectively, of the total loss. Damage exceeded $3 million in each of the basins of the South Santiam, North Santiam, and Clackamas Rivers. On the Middle Santiam River, approximately $900,000 in flood damage occurred at the Green Peter damsite when a construction cofferdam washed out.

Flood damage for main-stem river reaches and for tributary streams is summarized in table 9.

COASTAL OREGON

The widespread floods of December 1964 and January 1965 in coastal Oregon took six lives in December and caused flood damage of $53 million in areas within and $9 million in areas outside the influence of present or anticipated future-control projects. Damage was six times that caused by the December 1955–January 1956

TABLE 9.—*Flood damage in the Willamette River basin, December 1964 and January 1965*

[Compiled by U.S. Army Corps of Engineers, Portland District]

Stream basin and reach	Flood damage (thousands of dollars)								
	Agricultural	Residential	Commercial and industrial	Transportation	Utilities	Public facilities	Channel improvement and control structures	Emergency relief	Total
Willamette River main stem:									
Eugene, mile 186 to 176	55	44	98	56	46	3		78	380
Harrisburg, mile 176 to 155	1,672	4	54	83	6		197	30	2,046
Albany, mile 155 to 114	1,211	178	284	405	108	14	138	65	2,403
Salem, mile 114 to 84	2,635	122	1,839	2,969	232	273	320	92	8,482
Grand Island, mile 84 to 61	3,541	468	357	288	100	90		31	4,875
Newberg, mile 61 to 44	703	20	2	110	12	15	1	4	867
Oregon City, mile 44 to 26	140	878	6,430	44	78	5	178	64	7,817
Portland, mile 26 to 0		2,325	7,524	331	207	353	357	113	11,210
Total	9,957	4,039	16,588	4,286	789	753	1,191	477	38,080
Tributary basins:									
Coast Fork	247	34	103	56	1		135	2	578
Middle Fork	103	5	5	184			793	2	1,092
McKenzie River	344	225	148	274	21	32	423	9	1,476
Long Tom River and Amazon Creek	151			104			99	2	356
Marys River and West Muddy Creek	59	4	67	16	52			13	211
East Muddy Creek	18	1						1	20
Calapooia River	460	11	56	213	7		2	27	776
Santiam River main stem	772		6	746	16		162	6	1,708
South Santiam River	1,551	464	404	997	72	37	[1]2,185	38	5,748
North Santiam River	793			2,589	32	5	466	19	3,904
Luckiamute River	315		75	100	13	2		2	507
Yamhill River	318	52	220	145		5	1	8	749
Pudding River and tributaries	373	32	25	93	9		41	4	577
Molalla River	366	240	182	162	6	99	204	48	1,307
Tualatin River	178	74	31	131	6	2	55	2	479
Clackamas River	415	1,256		2,770	2,312	16	265	87	7,121
Johnson Creek	1	278	147	50	3	18		2	499
Total	6,464	2,676	1,469	8,630	2,550	216	4,831	272	27,108
Grand total	16,421	6,715	18,057	12,916	3,339	969	6,022	749	65,188

[1]Includes approximately $900,000 damages to Corps of Engineers facilities at Green Peter damsite.

flood. Nearly 50 percent of the damage occurred in the Umpqua River basin, 31 percent in the Rogue River basin, and 6 percent in the Coquille River basin; 13 percent was distributed throughout the other coastal basins. Agricultural, residential, commercial and industrial, and transportation damages were nearly equal in amount and were the principal items of monetary loss. The largest concentration of damage probably was at Reedsport, where the floodwater topped levees and inundated the town, causing damage of $4 million. More than 1,000 homes were inundated in the Rogue River valley, and many bridges and homes were demolished by floating debris. The loss of thousands of logs, washed away from mills along the coast, was a severe blow to Oregon's principal industry, and logs contributed to the heavy debris loads of the streams.

Flood damage for coastal Oregon is summarized under eight categories in table 10.

MINOR AREA OF FLOODING IN WASHINGTON

Damage caused by the floods of late January 1965 in the White River and the Green River basins in Washington was estimated at $327,000 by the Corps of Engineers, Seattle District. Seventy-one percent of this amount was attributed to transportation damage. The flood damaged mainly roads and bridges in the sparsely populated middle parts of the basins. Reservoir storage behind Howard Hanson Dam prevented about $5 million damage in the Green River basin; and storage behind Mud Mountain Dam prevented about $1.7 million damage in the White River basin.

Although peak discharges were not outstanding, damage in other river basins of western Washington, such as those of the Chehalis, Snohomish, and Cedar Rivers, exceeded $2 million. Agricultural and transportation damages constituted the principal losses in these basins.

FLOOD-CREST STAGES

Maximum-stage data for the floods of December 1964 and January 1965 were obtained at numerous points along the main stems and key tributaries of several principal streams in the flood area. These data include the maximum stages recorded or observed at regular gaging stations and at stations established for stage observation only, as well as high-water elevations determined from flood surveys.

Flood-crest stages at selected sites on the San Joaquin River and four of its tributaries are given in table 11, the Sacramento River and two tributaries in table 12, the Russian River and one tributary

TABLE 10.—*Flood damage in coastal Oregon, December 1964 and January 1965*

[Compiled by U.S. Army Corps of Engineers, Portland district. Does not include $9 million outside present or anticipated future flood-control project areas]

Stream basin	Flood damage (thousands of dollars)								
	Agricultural	Residential	Commercial and industrial	Transportation	Utilities	Public facilities	Channel improvement and control structures	Emergency relief	Total
Nehalem River	169	48	5	102	0	4	0	0	328
Miami River	28	0	30	20	0	0	0	0	78
Kilchis River	82	2	30	0	0	0	0	0	114
Wilson River	293	101	307	76	0	3	30	8	818
Trask River	201	63	156	49	0	9	1	4	483
Tillamook River	141	1	71	0	0	0	0	4	217
Nestucca River	461	67	77	28	7	13	0	2	655
Little Nestucca River	19	0	0	3	0	10	0	0	32
Siletz River	82	78	49	166	0	14	0	2	391
Yaquina River	50	14	147	41	0	1	1	1	255
Alsea River	86	213	48	123	0	20	0	2	492
Siuslaw River	68	221	692	260	3	1	45	4	1,294
Umpqua River	5,025	6,454	4,776	6,438	1,192	922	740	417	25,964
Coos River	379	32	411	289	16	2	60	2	1,191
Coquille River	1,441	79	893	178	41	3	323	115	3,073
Rogue River	3,315	4,805	3,102	2,467	582	379	1,416	316	16,382
Chetco River	42	28	314	99	8	146	27	9	673
Miscellaneous coastal streams	81	0	24	23	0	1	0	1	130
Grand total	11,963	12,206	11,132	10,362	1,849	1,528	2,643	887	52,570

TABLE 11.—*Flood-crest stages, December 1964 and January 1965 and December 1955–January 1956, in the San Joaquin River Basin, California*

[Agency supplying data: BR, U.S. Bureau of Reclamation; DWR, California Department of Water Resources; GS, U.S. Geological Survey; SF, city of San Francisco, Calif.]

Stream and location	Miles upstream from mouth	December 1964 and January 1965			December 1955–January 1956	Agency supplying data
		Day	Time (hr)	Altitude (ft)	Altitude (ft)	
San Joaquin River:						
Friant, 2 miles downstream from Friant Dam, left bank	268.1	Jan. 7	1000	296.6	302.7	GS
Sand Slough, 5 miles northwest of Santa Rita bridge, State Highway 152, right bank	173.6	Jan. 8	0540	106.5		DWR
Stevinson, 2.3 miles south, at Lander Avenue bridge	137.2	Jan. 9	1340	72.2		DWR
Fremont Ford Bridge, 6.7 miles upstream from Merced River	130.5	Jan. 10	0700	64.6	69.9	BR, DWR, GS
Newman, at Hills Ferry Road bridge, 500 feet downstream from Merced River	123.7	do	0800	62.7	65.1	DWR, GS
Crows Landing bridge, 0.3 mile downstream from Merced River	113.5	do	1820	53.9	57.8	DWR
Patterson, 3.1 miles northeast, at Patterson-Turlock bridge	105.0	do		48.7		DWR
Grayson, left bank of Laird Slough channel of San Joaquin River at Westley-Modesto highway bridge, 5 miles upstream from Tuolumne River	96.0	Jan. 12	0600	39.2	42.0	DWR, SF
Maze Road bridge, State Highway 132, 2.2 miles upstream from Stanislaus River	81.8	do	1140	31.9	35.6	DWR
Vernalis, at Durham Ferry bridge, 3.0 miles downstream from Stanislaus River, left bank	76.7	do	1300–1900	28.3	32.3	GS
Mossdale, just downstream from U.S. Highway 50 bridge, right bank	58.9	do	1820	14.1	20.6	DWR
Antioch, at wharf, city water works, left bank	4.5	Dec. 27		5.0	6.2	DWR
Merced River:						
Merced Falls (Exchequer) 0.6 mile downstream from Lake McClure	62.2	Jan. 7	0800	326.1		GS
Snelling, at Merced-Snelling highway bridge	41.9	do	1230	238		DWR
Cressy, 150 feet downstream from highway bridge, right bank	27.6	do	2040	123.6		DWR
Livingston, 4.5 miles west, left bank	9.5	Jan. 8	0400	100.1		DWR
Stevinson, right bank	4.6	do	1900	72.1	74.2	DWR, GS, SF
Tuolumne River:						
Above La Grange Dam, 0.5 mile downstream from Don Pedro dam	57.0	Jan. 7	0745	344	364	GS
La Grange bridge	50.5	do	0340	176.5	184.1	DWR
Roberts Ferry Bridge, 7.5 miles east of Waterford	39.9	Jan. 6	1710	117.1	125.2	DWR
Hickman-Waterford Bridge	31.5	Dec. 24	1920	78.9	91.9	DWR

Modesto, just upstream from U.S. Highway 99 bridge, left bank	16.0	Jan. 7	2030	55.4	66.4	DWR, GS
Tuolumne City, at highway bridge	3.4	Jan. 8	0300	39.5	46.3	DWR
Stanislaus River:						
Below Melones powerhouse, 1 mile downstream from Melones Dam	65.3	Dec. 24	1130	525.0	529	GS
Knights Ferry, 3 miles northeast, 1.0 mile downstream from Goodwin Dam, right bank	55.1	do	1300–1400	281.7		GS
Orange Blossom Bridge, 5.7 miles upstream from Oakdale, right bank	44.7	do	1710	137.3	142.7	DWR
Riverbank, at Burneyville Bridge	32.0	do	2240	98.0	103.2	DWR
Ripon, 1 mile southeast, just downstream from railroad bridge, left bank	15.9	Dec. 25	0600	63.0	63.2	GS
Koetitz Ranch, 0.6 mile northeast of Bacon and Gates Road junction, left bank	9.4	do	0710	49.8		DWR
Mokelumne River:						
Camanche Dam, 1.0 mile downstream, 3.4 miles northeast of Clements, left bank	62.5	Dec. 31	0345	90.8		GS
Clements, 700 feet upstream from Ione highway bridge, left bank	59.0			(1)	91.0	
Woodbridge, 0.4 miles downstream from Woodbridge Irrigation District diversion dam, left bank	38.8	Jan. 3	1900	32.1	43.9	GS
Thornton, 2.3 miles northwest, at Bensons Ferry highway bridge	5.5	Dec. 24	0910	12.1		DWR
Georgianna Slough, right bank, 300 feet upstream from Mokelumne River, 2.8 miles southeast of Isleton	3.4	Dec. 27		5.5	10.3	DWR

[1]Not available.

TABLE 12.—*Flood-crest stages, December 1964 and January 1965 and December 1955–January 1956, in the Sacramento River basin, California*

[Agency supplying data: BR, U.S. Bureau of Reclamation; CE, U.S. Army Corps of Engineers; DWR, California Department of Water Resources; GS, U.S. Geological Survey; WB, U.S. Weather Bureau]

Stream and location	Miles upstream from mouth	December 1964 and January 1965			December 1955–January 1956	Agency supplying data
		Day	Time (hr)	Altitude (ft)	Altitude (ft)	
Sacramento River:						
Keswick, 0.8 mile downstream from Keswick Dam, right bank	309.3	Dec. 27	1100	507.4	506.7	GS
Redding, 0.5 mile downstream from Anderson-Cottonwood Irrigation District diversion dam, left bank	299.7			(1)	451.1	DWR
Balls Ferry, left bank	283.5			(1)	369.7	DWR
Red Bluff, 5 miles upstream, left bank	257.6	Dec. 22	2100	281.7	275.5	GS
Red Bluff, U.S. Highway 99E bridge, east end	252.4	do	2100	264.3	260.6	GS
Vina, 2.6 miles southwest, 250 feet about Vina-Corning highway bridge, right bank	225.5	Dec. 23	0600	187.9	184.3	DWR
Hamilton City, 1.0 mile northeast at Gianella Bridge, left bank	208.5	do	1220	146.1	143.3	DWR
Ord Ferry, 0.1 mile downstream, right bank	189.8	do	1850	115.9	115.6	DWR
Butte City, 0.5 mile downstream, left bank	174.8	Dec. 24	0600	92.0	91.6	GS
Moulton weir, opposite, right bank	162.9	do	1000	80.0	80.2	DWR
Colusa, just downstream from highway bridge, right bank	148.4	Jan. 7	1300	64.1	63.8	DWR, GS
Meridian bridge, State Highway 20	138.8	do	1520	57.6	58.2	DWR
Tisdale Weir, north end, left bank	123.2	Dec. 25	1800	47.1	47.9	CE, DWR
Wilkins Slough, 0.3 mile downstream from Reclamation District 108 irrigation pumping plant, right bank	121.9	do	1200–2000	46.9	47.6	GS
Knights Landing, just upstream from Southern Pacific Railroad bridge, left bank	93.0	do	0800	38.1	38.2	GS
Fremont Weir, upstream end, right bank	87.0	do	0500	36.5	36.7	CE, DWR, GS
Fremont Weir, downstream end, right bank	82.0	do	0110	35.7	35.6	DWR
Verona, 1 mile downstream from Feather River, left bank	78.6	do	0600–0700	36.6	36.7	GS
Elkhorn Ferry, 250 feet upstream at Woodland Farms, Inc., pumphouse, right bank	70.8	do	1420	32.9		DWR
Sacramento Weir, 100 feet downstream, right bank	63.2	do	0300–0500	29.3	28.9	CE, DWR
Sacramento, 1,000 feet upstream from I Street bridge, left bank	59.4	do	0300	29.4	28.8	DWR, GS, WB
Freeport, 1.9 miles northwest, right bank	48.6	do	0930	23.6	23.9	DWR, GS
Snodgrass Slough, 0.25 mile upstream, left bank	36.7	do	1340	17.6	17.5	DWR, GS
Walnut Grove, just upstream from Georgianna Slough, left bank	26.5	do		12.2	13.0	DWR
Isleton, left bank	17.4	Dec. 26		8.0	8.4	BR
Rio Vista, 1 mile downstream	11.7	do		5.8	7.2	CE
Collinsville, right bank	.2	Dec. 27		5.2	6.2	DWR

Feather River:						
Oroville, 0.6 mile northeast, 300 feet from fish barrier dam, right bank	66.0	Dec. 23	0600–1300	174.2		GS
Gridley, 2.7 miles east, at Oroville-Gridley highway bridge, left bank	49.7	do	0830–1200	97.5	99.2	DWR
Yuba City, Sacramento-Northern Railway bridge, right bank	28.0	do	1200	73.4	79.4	DWR
Shanghai Bend, 4 miles south of Yuba City, right bank	24.0	do	1240	67.8	73.8	DWR
Nicolaus, 0.5 mile southwest, at highway bridge, left bank	9.2	do	1430	48.2	48.6	GS
American River:						
Fair Oaks, 2.4 miles east, 2,100 feet downstream from Nimbus Dam, right bank	19.3	Dec. 23 to 25	1230 1000	99.2		GS
Sacramento, at H Street bridge, left bank	6.5	Dec. 24	1100	38.8	35.9	DWR
Elvas, Southern Pacific Railroad bridge				[1]	32.5	DWR, GS
Garden Highway, bridge				[1]	29.6	DWR

[1]Not available.

in table 13, and the Eel River and three tributaries in table 14. All these sites are in California. Flood-crest stages for the Willamette River in Oregon are given in table 15. The agencies that operated the gages, made the surveys, or otherwise provided the data, are indicated in the tables.

The maximum stages at selected sites in the San Joaquin River and Sacramento River basins in California recorded during the floods of December 1964 and early January 1965 are presented in tables 11 and 12. The principal floods occurred generally in December, but the floods of early January were greater in a few tributary basins or local areas in both the San Joaquin River and Sacramento River basins. Storage and bypass regulation and flows from intervening tributaries caused substantial modifications of flows in the San Joaquin River between Friant Dam and the Stanislaus River and in the Sacramento River from Shasta Lake to the Sacramento-San Joaquin Delta. The tabulations of crest stages in these reaches do not represent the continuous downstream travel of a single wave but include, particularly in the San Joaquin River, the composite effect of storage regulation and runoff from a second flood. Maximum stage and discharge commonly occur concurrently, but in the delta reaches of the lower San Joaquin and Sacramento Rivers and on the Willamette River at Portland the maximum stages shown may not be indicative of the maximum discharge, owing to tidal effects.

Stage data for the floods of December 1955–January 1956 at many sites in these basins are also shown in tables 11 and 12. These stage data indicate the magnitude of the floods of 1964–65 in relation to those of 1955–56 along the main stems and lower reaches of the key tributaries. The flood magnitudes in these streams were modified somewhat in 1955–56, and to a greater extent in 1964–65, by the storage regulation available and the operation of flood-control facilities.

Maximum stages for the floods of December 22–23, 1964, in the Russian River and Eel River basins in north-coastal California are listed in tables 13 and 14. Most of the data were obtained by the Corps of Engineers by leveling to floodmarks, but the time of occurrence of the floods could not be established. Stage data for the flood of December 22–23, 1955, at regular gaging stations on the Russian River and Dry Creek are also shown in table 13. Floodflows in the Russian River in December 1964 were reduced substantially as a result of the complete regulation by Lake Mendocino of the flood runoff in the East Fork Russian River. Many of the flood elevations in the Eel River basin were obtained at points used in previous surveys. The December 1955 crest stages at many points

TABLE 13.—*Flood-crest stages, December 1964 and December 1955, in the Russian River basin, California*

[Agency supplying data: CE, U.S. Army Corps of Engineers; GS, U.S. Geological Survey]

Stream and location	Miles upstream from mouth	Altitude (ft) December 22–23, 1964	Altitude (ft) December 22–23, 1955	Agency supplying data
Russian River:				
Redwood Valley, at gage 3.8 miles north	105.2	811.4		GS
Redwood Valley	101.1	705.3		CE
Ukiah, at gage 3.6 miles north	96.7	631.4	633.0	GS
Ukiah, bridge on Regina Heights road	92.7	594.9		CE
Hopland, at gage 4 miles north	82.2	523.6	524.6	GS
Mouth of Feliz Creek at Hopland	77.2	491.4		CE
Cloverdale, at gage 5 miles northwest	69.7	405.2	404.5	GS
Cloverdale, mouth of Big Sulphur Creek	63.4	311.2		CE
Cloverdale	62.8	302.7		CE
Asti	58.6	263.5		CE
Geyserville	53.1	209.0		CE
Jimtown	47.6	178.3		CE
Mouth of Maacama Creek	43.2	154.8		CE
Healdsburg, at gage 2 miles east	34.9	104.0	103.2	GS
Healdsburg, mouth of Dry Creek, 1.2 miles south of U.S. Highway 101 bridge	31.9	87.7		CE
Mouth of Mark West Creek	23.6	73.7		CE
Gage, 3.4 miles east of Guerneville	20.5	66.8	67.0	GS
Korbel	18.0	62.2		CE
Rio Nido	16.8	59.1		CE
Guerneville	15.2	55.7		CE
Monte Rio	10.2	41.9		CE
Duncans Mills	6.2	28.2		CE
Bridge at State Highway 1	2.2	18.1		CE
Jenner, 0.6 mile west	.2	9.2		CE
Dry Creek:				
Cloverdale, at gage 5 miles southwest	19.5	322.1	321.8	GS
Bridge at narrows 0.7 mile downstream from Warm Springs Creek	13.3	205.4	208.5	CE
Geyserville, at gage 3 miles west	10.4	177		GS
Right bank opposite Manzanita School	4.1	121.9		CE
Healdsburg, at sewage disposal plant	2.1	99.5		CE
Healdsburg, mouth at mile 31.9 on main stem	.0	87.7		CE

along the Eel River main stem and key tributaries are also shown in table 14 to provide comparative data that may be useful in studies of further hydrologic developments along these streams.

The maximum stages observed for the flood of December 1964 in the Willamette River from Eugene to Portland, Oreg., are listed in table 15. The estimated natural stages (without the effect of regulation by reservoirs) for the December 1964 flood, which were determined by the Corps of Engineers, and the observed crest stages for the floods of December 1955, January 1943, and December 1861 are presented also for comparison. The stage data were determined from records at gaging stations or from flood profiles developed by the Corps of Engineers. There were seven major flood-control reser-

TABLE 14.—*Flood-crest stages, December 1964 and December 1955, in the Eel River basin, California*

[Agency supplying data: CE, U.S. Army Corps of Engineers; GS, U.S. Geological Survey; NPR, Northwestern Pacific Railroad]

Stream and location	Miles upstream from mouth	Altitude (ft) December 22–23, 1964	Altitude (ft) December 22–23, 1955	Agency supplying data
Eel River (main stem):				
Lake Pillsbury	163.5	1,830.1	1,827.5	GS
Gage 0.7 mile downstream from Scott Dam	162.8	1,764	1,760	GS
Gage 1,000 feet downstream from Van Arsdale Dam	152	1,434	1,430	GS
Gage 2.1 miles south of Dos Rios	116	1,005	1,000	GS
Mouth of Middle Fork Eel River at Dos Rios	114	925.6	910	CE
Gage 2.2 miles downstream from Middle Fork Eel River	112	883.3	871	GS
Bell Springs	94	709		NPR
Island Mountain	83	553		NPR
Gage at Alderpoint	69	357	340	GS
Eel Rock	54	245		NPR
McCann	47	198		NPR
Mouth of South Fork Eel River	41	179.2	165.6	CE
Holmes	35	148.8	137.1	CE
Shively	33	143.9	133.3	CE
Elinor	30	140.0	128.6	CE
Stafford	27	132.5	118.6	CE
Scotia, gage at bridge 0.5 mile north	22.5	107.5	98.0	GS
Mouth of Van Duzen River	14.7	64.0	58.0	CE
Fernbridge	8.5	33.6	32.0	CE
Arlynda Corners	7.0	21.9		CE
Eel River School on Cannibal Road	.5	13.5	11.6	CE
Middle Fork Eel River:				
Mouth of Black Butte River	30.4		1,469.6	
Gage 0.2 mile downstream from Black Butte River	30.2	1,466.8		GS
Mouth of Williams Creek	27.9		1,396.4	
Dos Rios, upstream	1.5	946.2		CE
Dos Rios	.3	929.8		CE
Mouth (mile 114 on Eel River main stem)	.0	925.6	910	CE
South Fork Eel River:				
Branscomb, at gage 4.7 miles north	71	1,399.7	1,403.6	GS
Leggett	56	746.2		CE
Lane Redwood Flat	52	666.3	664.8	CE
Piercy	44	516.5	515.0	CE
Richardson Grove	40	456.1	443.6	CE
Benbow	34	385.8	380.5	CE
Garberville	30	326.1	324.7	CE
Redway	27	308.2	303.6	CE
Gage 4.3 miles southeast of Miranda	21	263.6	260.3	GS
Phillipsville	18.5	245.1	240.1	CE
Miranda, 1 mile downstream	13.5	228.1	220.8	CE
Myers Flat	7.5	205.0	197.0	CE
Burlington	5.0	190.6	177.7	CE
Weott	2.5	185.2	171.6	CE
Mouth (mile 41 on Eel River main stem)	.0	179.2	165.6	CE
Van Duzen River:				
Gage 2.8 miles west of Dinsmores	44	2,019.4		GS
Bridgeville, at site of former gage	28		622.0	
Gage 4 miles west of Bridgeville	24	423	420	GS
Grizzly Creek State Park	21	371.4		CE
Cummings Creek Camp	9	159.5		CE
Carlotta	6	118.2		CE
Hydesville	3.5	87.2		CE
Flood plain near Alton	1.8	70.2		CE
Bridge at U.S. Highway 101	.6	65.1		CE
Mouth (mile 14.7 on Eel River main stem)	.0	64.0	58.0	CE

TABLE 15.—*Flood-crest stages, floods of 1964, 1955, 1943, and 1861, in the Willamette River in Oregon*

[Agency supplying data: CE, U.S. Army Corps of Engineers; GS, U.S. Geological Survey]

Site	Miles upstream from mouth	Altitude (ft) December 1964 Observed	Altitude (ft) December 1964 Estimated natural [1]	Altitude (ft) December 1955 Observed	Altitude (ft) January 1943 Observed	Altitude (ft) December 1861 Observed	Agency supplying data
Eugene	182.2	411	421	412	421	423	CE
Mouth of McKenzie River	175	376	382	374	378	384	CE
Harrisburg	161.2	307.6	310.9	306.3	309.2	311	GS
Mouth of Long Tom River	145.9	248	254	247	250	255	CE
Corvallis	131.4	217.8	223.6	215	218	223	CE
Albany	119.3	201.1	207.4	198.9	202.3	208	GS
Mouth of Santiam River	109	182	193	180	186	193	CE
Independence	96.1	158	168	155	159	169	CE
Salem	84.1	143.9	151.4	139.6	144.1	153	GS
Wheatland	72	114	126	110	113	127	CE
Mouth of Yamhill River	54.9	106	117	96	103	118	CE
Wilsonville	39	94.7	102.8	85.9	91	105	GS
Mouth of Molalla River	35.7	92	101	82	88	102	CE
Mouth of Tualatin River	28.4	72.3	78	67	70	72	CE
Oregon City, upper	26.6	70.1	73.5	....	....	....	CE
Oregon City, lower	26.3	49.6	60.3	....	....	....	CE
Portland	12.8	31.4	36.0	23	21	26	CE

[1]Estimated by Corps of Engineers.

voirs in operation during the December 1964 flood; four of these were in operation in 1955 and two in 1943, but none existed in 1861. Crest stages that occurred at Portland during the floods of June 1894 and May 1948 as a result of backwater from high stages in the Columbia River were higher than those in December 1964.

STORAGE REGULATION

Reservoir storage substantially reduced the magnitude of peak floodflows on many streams in the flood-affected area. The storage was provided by flood-control reservoirs and many reservoirs constructed primarily for water conservation or for hydroelectric-power production purposes. Some of the more significant effects were mentioned in the preceding discussions of the floods and of the flood damage. Pertinent information on flow regulation or flood peak reduction by the major reservoirs in the hydrologic regions of the flood area are discussed briefly in the following sections.

THE GREAT BASIN

Reservoir storage in stream basins draining the eastern slope of the Sierra Nevada reduced the magnitude of flood runoff in the southern part of the Great Basin. The upper Carson River basin has relatively little storage capacity, and the effect of any regulation on flood peaks is slight. However, the Lahontan Reservoir on the lower Carson River, operated principally for irrigation and power purposes, fully contained the inflow from the December 1964 flood and reduced a moderate-sized flood to nondamaging flows; thus flood damage in the city of Fallon, Nev., and in the highly developed irrigated area nearby was prevented.

Lake Tahoe contained nearly all the flood runoff from the Truckee River basin upstream from the outlet of the lake. During the period December 19–30, the lake rose 1.9 feet, and the contents increased 234,000 acre-feet; the outflow from the lake was controlled to an average flow of 70 cfs and a maximum daily flow of 116 cfs December 23. The lake levels rose 2.4 feet during the period December 19–January 31, and the contents increased 295,000 acre-feet; the outflow was less than 10,000 acre-feet. The small outflow, in relation to peak discharge downstream, is characteristic of Lake Tahoe, which has a large storage capacity in comparison to the yield of the contributing area.

The reservoir on Prosser Creek, a tributary of the Truckee River, detained a peak inflow of 6,500 cfs December 23. The outflow was reduced to about 50 cfs at the time of peak inflow and was less than 500 cfs throughout the critical flood period December 21–24. Boca Reservoir, near the mouth of the Little Truckee River, detained a peak inflow of 10,600 cfs December 23, and the outflow only increased from 84 to 1,100 cfs between December 21 and 24. The maximum outflows from the two reservoirs occurred December 25, more than 48 hours after the peak flows in the Truckee River, and were less than 30 percent of the peak inflows. The combined storage in Prosser Creek and Boca Reservoirs significantly reduced the peak discharge in the Truckee River downstream from the reservoirs and past Reno, Nev. Flood-routing studies by the Corps of Engineers indicated that the flow reduction at Reno was about 14,000 cfs and that the reduction prevented a record peak, very heavy flood damage, and possible loss of life, particularly in the Reno-Sparks area. Pyramid Lake, at the lower end of the Truckee River, rose 0.7 foot between November 28 and December 29, 1964, and an additional 0.7 foot between December 29 and February 4, 1965.

SAN JOAQUIN RIVER AND SACRAMENTO RIVER BASINS

Reservoir storage substantially reduced the magnitude of peak floodflow in many streams in the San Joaquin River and Sacramento River basins. The storage was provided by many reservoirs constructed primarily for irrigation, power, and water-conservation purposes; by large multipurpose reservoirs that include reservations for flood-control storage; and by several reservoirs constructed specifically for flood control. The major reservoirs in the region are listed in table 16, which includes data on the storage space available at the beginning of the floods of December 1964 and early January 1965, on the storage space used, and on the peak inflow and the peak outflow. Several small flood-control reservoirs are included. In many reservoirs the detention of floodflows caused moderation of the peak discharge, and the peak outflows were delayed, many for several days. The resulting effect on downstream peak discharges, thus, was more substantial than indicated by the differences in the peak inflows and outflows shown in the table.

The major reservoirs in the San Joaquin River basin are on the east side of the valley on streams draining the Sierra Nevada. Flood runoff in the upper San Joqauin River was largely contained in the numerous power and water-conservation reservoirs in the headwater areas and in Millerton Lake. In the San Joaquin Valley the large storage capacity in the many miles of channels and sloughs and in bypass channels provided additional regulation. Lake McClure, on the Merced River, fully stored the December floodflows, but was filled by runoff from the early January storm. A peak flow of 11,000 cfs occurred January 8 downstream in Merced River at Stevinson (site 114). Tuolumne River flows were largely contained in Don Pedro Reservoir and in the Hetch Hetchy system reservoirs upstream. The peak discharge of 11,100 cfs in Tuolumne River at Modesto (site 143) January 7 consisted of the controlled release of 8,150 cfs from Don Pedro Reservoir and runoff from the intervening area. On the Stanislaus River and the heavy flood runoff exceeded the available reservoir capacity, and the outflow from Tulloch Reservoir reached a peak of 41,000 cfs December 24. Channel storage reduced this peak discharge to 32,800 cfs December 25 at the gaging station at Ripon (site 163).

Discharge in San Joaquin River near Vernalis (site 164) was controlled to about 20,000 cfs during the critical flood period and reached a maximum of 22,800 cfs January 12, as compared to the record flows of 79,000 cfs in 1950 and 50,900 cfs in 1955. The relatively low but sustained floodflow near Vernalis resulted from the storage regulation afforded by the reservoirs on the major tributaries (the Merced, Tuolumne, and Stanislaus Rivers), the channel storage on these tributaries downstream from the reservoirs and on the main stem, and the absence of coincidence in the peak flows from the tributaries. The New Hogan Reservoir on the Calaveras River and

TABLE 16.—*Reduction of December 1964 and January 1965 flood discharge by storage regulation in the San Joaquin River and Sacramento River basins in California*

[Compiled by U.S. Army Corps of Engineers, Sacramento District]

Reservoir	Stream basin	Available storage space at beginning of flood (acre–ft)	Storage space used (acre–ft)	Peak inflow (cfs)	Peak outflow (cfs)
San Joaquin River basin					
Millerton Lake	San Joaquin River	294,500	78,900	9,000	69
Mariposa	Mariposa Creek	15,000	3,920	[1] [2]3,650	[1] [2]820
Owens	Owens Creek	3,600	224	[1] [2]933	[1] [2]120
Bear	Bear Creek	7,700	1,080	[1] [2]6,940	[1] [2]1,340
Burns	Burns Creek	6,800	290	[1] [2]6,070	[1] [2]1,670
Lake McClure	Merced River	263,300	203,300	35,000	[2]16,800
Lake Eleanor (Lake Lloyd)	Tuolumne River	24,300	25,400	...	[1] [2]667
Cherry Valley	do	257,600	86,400	[1]11,670	[1]5
Hetch Hetchy	do	347,200	247,100	[1]19,800	[1]784
Don Pedro	do	203,000	117,800	43,400	[2]8,150
Beardsley	Stanislaus River	61,500	42,800	9,930	2,840
Donnells	do	38,800	33,100	12,900	7,620
Melones	do	70,200	73,200	48,700	39,000
Tulloch	do	14,500	15,800	43,300	41,000
Farmington	Littlejohn Creek	52,000	15,500	18,100	2,220
New Hogan	Calaveras River	308,200	94,800	21,000	[2]1,640
Lower Bear	Bear River	18,300	18,300	[1]7,560	([3])
Salt Springs	Mokelumne River	134,500	75,100	32,000	4,780
Pardee	do	8,200	18,800	32,100	28,400
Camanche	do	375,900	165,900	28,400	2,900
Jenkinson Lake	Cosumnes River	11,400	11,640	[1]1,290	[1] [2]377
Sacramento River basin					
Shasta Lake	Sacramento River	1,963,000	792,000	187,000	54,500
Whiskeytown	Clear Creek	32,000	36,200	20,900	3,640
East Park	Stony Creek	36,400	30,100	[1]4,800	0
Stony Gorge	do	36,300	37,000	29,600	18,200
Black Butte	do	131,000	68,100	47,000	19,300
Frenchman Lake	Feather River	21,900	7,000	[1]8,090	[1]2
Lake Almanor	do	141,700	145,800	30,000	46
Butt Valley	do	8,500	3,900	3,400	...
Bucks Lake	do	60,500	34,900	...	...
Oroville Dam embankment	do	[4]650,000	155,200	250,000	158,000
Lake Fordyce	Yuba River	27,460	18,360	...	...
Lake Spaulding	do	24,700	16,900	...	...
Bowman Lake	Yuba River	36,900	36,900	...	2,600
Englebright	do	23,960	8,880	176,000	171,000
Scotts Flat	do	43,690	24,110	...	0
Rollins	Bear River	54,630	54,630	...	([3])
Camp Far West	do	57,000	72,000	...	12,000
Loon Lake	American River	67,600	19,790	...	[1]287
Union Valley	do	130,700	89,140	...	[1]4,480
Ice House	do	34,180	22,180	...	...
Folsom Lake	do	433,000	322,000	280,000	115,000
Clear Lake	Cache Creek	254,000	210,000	...	4,680
Lake Berryessa	Putah Creek	244,000	210,000	67,100	[2]8,950

[1]Daily.
[2]Occurred about January 7, 1965.
[3]Spilled.
[4]Dam under construction; 650,000 acre-ft capacity available to top of embankment.

the new Camanche Reservoir on the Mokelumne River, in combination with the upstream Salt Springs and Pardee Reservoirs, provided complete regulation of flood runoff in these basins.

Reservoir storage was particularly effective in reducing the magnitude of flood runoff and damage in the Sacramento River basin. Outstanding regulation was afforded by Shasta Lake on the Sacramento River, Lake Almanor on the North Fork Feather River, Union Valley Reservoir and Folsom Lake in the American River basin, Clear Lake on Cache Creek, and Lake Berryessa on Putah

Creek. The peak inflow of 187,000 cfs to Shasta Lake (site 236) December 22 was fully contained, and outflow was controlled to 6,000 cfs during the critical flood period. At the Oroville Dam, under construction on the Feather River, the partly completed embankment was effective in the detention of a record peak inflow of 252,000 cfs; the subseuqent outflow reached a maximum of 158,000 cfs 17 hours later. Folsom Lake on the American River fully contained flood runoff in the basin, including a tremendous flood wave released down the Middle Fork American River by failure of the partly completed Hell Hole Dam on the Rubicon River. Inflow to Folsom Lake had peaked at 214,000 cfs and was receding when the flood surge raised the peak inflow to a recordbreaking 280,000 cfs; however, outflow was controlled to 115,000 cfs, the design capacity of the American River levee system. The storage of about 325,000 acre-feet of water in Clear Lake during the flood period and the regulation of outflow reduced high basin runoff to 5,320 cfs January 5 in Cache Creek near Lower Lake (site 409). Lake Berryessa on Putah Creek retained the full flood runoff and reduced the peak inflow of 67,100 cfs December 22 to a controlled peak outflow of 7,740 cfs January 7 at the station near Winters (site 425). The extensive bypass system, many square miles of lowlands, and the many miles of levees, channels, and sloughs in the Sacramento River Flood Control Project, combined with channel storage in the valley reaches of the Sacramento River and tributaries, provided a large storage capacity that aided very significantly in limiting peak flow on the lower Sacramento River and in reducing flood damage.

NORTH-COASTAL CALIFORNIA

Three major storage reservoirs in north-coastal California and several reservoirs in headwater areas or smaller basins were effective in reducing the magnitude of flood runoff and moderating flood damage during the floods of December 1964 and early January 1965. Storage in Lake Hennessey on Conn Creek, a tributary of the Napa River, reduced December floodflows downstream at Napa.

Lake Mendocino (capacity, 122,500 acre-ft), on East Fork Russian River near Ukiah, completely contained the floodflows during the critical periods for the December and January floods. The inflows of 18,700 cfs December 22 and 14,400 cfs January 5 exceeded previous record flows, but the outflows were controlled to 10 cfs; the resulting combined flows in the Russian River downstream from the confluence were only about 50 percent of the flow that would have occurred without the storage.

The outflow from Lake Pillsbury, the only reservoir in the Eel River basin, measured at the station below Scott Dam, near Potter Valley (site 484), reached a maximum of 56,300 cfs December 22 several hours after the probable time of peak inflow. This discharge exceeded previous maximum flows by about 37 percent, and moderation by storage probably was slight. The lake provides regulation for runoff from a headwater drainage area of 289 square miles

Ruth Reservoir (capacity, 42,000 acre-ft), in the upper Mad River basin, was constructed in 1962 primarily as a water-supply facility without flood-control storage. In December 1964 the reservoir provided enough detention of flood runoff from headwater areas to reduce the peak discharge at the midbasin gaging station on Mad River near Forest Glen (site 524) to 51 percent of the record flow in 1955, whereas the general heavy basin runoff produced a peak discharge at the downstream station near Arcata (site 528) that was 90 percent of the peak in 1955.

Upper Klamath Lake controls runoff in the upper Klamath River basin. Some modification of peak-discharge rates results also from the perviousness of the soil and mantle rock in the headwater regions and from natural storage provided by extensive marsh areas upstream from the lake. Peak discharges for the flood of December 1964 in streams tributary to Upper Klamath Lake were high, and those in the Sprague River were more than twice the previous record flows. Though the maximum daily inflow to the lake was about 20,000 cfs December 25, the maximum outflow was only about a third of this and occurred during the first week in January. Lake Dwinnell (capacity, 50,000 acre-ft), on the Shasta River in the Klamath River basin, stored flood runoff from 139 square miles, and thus provided some reduction in the extremely high flow of 21,500 cfs December 22 in Shasta River near Yreka (site 557). Clair Engle Lake, on the Trinity River (usable capacity, 2,437,700 acre-ft), fully contained flood runoff from a drainage area of 692 square miles upstream from Lewiston, Calif. The maximum bihourly inflow of 84,000 cfs December 22 (site 583) was 117 percent of the record flow in 1955 at the gaging station at Lewiston (site 584), but outflows were maintained at about 220 cfs during the flood period.

UPPER COLUMBIA RIVER AND SNAKE RIVER BASINS

Reservoir storage effectively reduced peak flows in streams in the Upper Columbia River and Snake River basins. In the Snake River basin, 12 major reservoirs, extending downstream from the American Falls Reservoir, stored 626,000 acre-feet of water during the critical

TABLE 17.—*Daily change in storage in reservoirs in the Snake River basin, Idaho and Oregon, during the flood period December 21–27, 1964*

[Compiled by U.S. Army Corps of Engineers, Walla Walla District]

Reservoir	Stream basin	Gain or loss (−) in storage (thousands of acre-ft)						
		December 1964						
		21	22	23	24	25	26	27
American Falls	Snake River	9.7	15.8	19.9	16.3	17.8	16.7	11.2
Magic	Big Wood River	.4	3.5	6.7	10.5	1.6	4.0	4.3
Owyhee	Owyhee River	2.2	2.4	19.7	41.1	33.1	17.4	13.0
Anderson Ranch	Boise River	.5	3.8	15.3	9.7	5.8	3.8	2.9
Arrowrock	do	3.2	26.4	30.9	21.0	13.5	9.2	7.8
Lucky Peak	do	.3	6.3	8.2	7.4	4.3	3.0	2.6
Warmsprings	Malheur River	1.0	4.0	12.0	10.0	8.0	5.0	4.0
Agency Valley	do	.1	.7	6.2	3.6	2.2	1.5	1.3
Bully Creek	do	.1	7.0	2.8	3.1	1.0	.7	.3
Deadwood	Payette River	.3	.8	2.4	2.0	1.3	1.0	1.0
Cascade	do	3.0	10.2	20.9	10.6	6.3	3.6	4.5
Brownlee	Snake River	−2.2	5.2	13.5	33.2	11.9	−10.4	−20.9

flood period, December 21–27. The daily gain or loss in storage in these reservoirs during this period is shown in table 17. Additional water was stored in Snake River reservoirs upstream from the flood area and in numerous small reservoirs throughout the entire region. In American Falls Reservoir, just upstream from the major flood area in Idaho, over 700,000 acre-feet of storage capacity was unused during the critical period of the flood. Magic Reservoir, in the Big Wood River basin, stored all the inflow, and the daily outflow in December did not exceed 8 cfs. Owyhee Reservoir on the Owyhee River in Oregon also stored all inflow, and the daily release was less than 6 cfs during the period December 21–27. As in December 1955, the three major reservoirs in the Boise River basin—Arrowrock, Anderson Ranch, and Lucky Peak—stored all the inflow during the critical period of the December flood. Downstream the flow of Boise River at Boise (site 715) was less than 300 cfs until January 11, as a result of the complete storage regulation. Warmsprings, Agency Valley, and Bully Creek Reservoirs in the Malheur River basin in Oregon and Deadwood and Cascade Reservoirs in the Payette River basin in Idaho also stored all inflow.

The peak discharge of 72,400 cfs December 25 in Snake River at Weiser (site 756) was equal to the 12-year flood and just above 70,000 cfs, the approximate flow at bankfull stage. Storage in Brownlee Reservoir on the Snake River downstream from Weiser also helped reduce flood peaks during the critical period.

During the flood of late January 1965, all the major reservoirs in the basin, except Bully Creek, had storage space available and were able to store the flood runoff. Spill from Bully Creek Reservoir contributed to flooding along the Malheur River downstream from

Vale, Oreg. The peak discharge on Snake River at Weiser (site 756) was about 62,000 cfs January 31, well below flood conditions.

In the upper Columbia River basin, flood storage was afforded in December primarily by Coeur d'Alene Lake and by the planned regulation of power reservoirs on the Columbia River. Natural storage in Coeur d'Alene Lake substantially modified a peak inflow of more than 100,000 cfs December 26, as indicated by the 30,900 cfs measured at the station on Spokane River at Post Falls, Idaho (site 639). On the Columbia River substantial storage space and ultimate flood control was obtained by scheduling the distribution of water and power production among the "run-of-river" powerplants. Flood-control operations on the upper Columbia River reduced the discharge downstream from Priest Rapids Dam from 80,000 cfs December 22 to 40,000 cfs December 24 and 25.

Storage in the major Snake River reservoirs and in the reservoirs in the upper Columbia River basin reduced the December 1964 flood stage of the lower Columbia River in the Portland-Vancouver area by approximately 2 feet, the Corps of Engineers estimated.

LOWER COLUMBIA RIVER BASIN

Storage in irrigation and power reservoirs during December 1964 substantially reduced flooding in parts of the basin and provided some reduction of flow in the lower Columbia River. In the Umatilla River basin, storage in McKay Reservoir near Pendleton reduced flooding on the Umatilla River in December. During the period December 21–31, about 22,000 acre-feet of water was stored, but only 36 acre-feet was released. Storage in several small flood-control and irrigation reservoirs reduced local flooding in December in parts of the Umatilla River basin and the Walla Walla River basin in Washington.

Prineville and Ochoco Reservoirs and Lake Billy Chinook in the Deschutes River basin in Oregon stored most of the runoff from upstream areas, although runoff downstream from the reservoirs produced the highest discharge in 62 years of record at the mouth of the Deschutes River. Prineville Reservoir on Crooked River (capacity, 154,700 acre-ft) and Lake Billy Chinook (capacity, 534,700 acre-ft), a power reservoir on the Deschutes River, each stored water at a rate of about 15,000 cfs during the critical period of the flood. Prineville Reservoir reduced a record peak inflow of about 20,000 cfs December 23 to a nondamaging outflow that reached a peak of only 3,300 cfs December 30 at Prineville (site 958), and it thus protected the city of Prineville and farmland downstream.

An outflow of about 4,000 cfs from Lake Billy Chinook was included in the record peak discharge December 22 at Moody at the mouth of the Deschutes River.

Major reservoirs in the headwaters of the Deschutes River such as the Crane Prairie and the Wickiup Reservoirs and Crescent Lake, which have a combined storage capacity of 355,000 acre-feet, were upstream from the area of major flooding and were not a major factor in reducing downstream discharge.

Natural storage is provided in the upper Deschutes River basin by the extremely porous lava which underlies much of the basin. A substantial part of the rain, snowmelt, and flood runoff in this area infiltrates into the ground, is stored, ultimately is released through numerous springs, and produces relatively high sustained streamflows in the summer months.

On the Lewis River in Washington, storage at the Swift, Yale, and Merwin power dams provided incidental reduction of flow in the lower Columbia River.

During the late January flood, storage in McKay Reservoir in the Umatilla River basin and in smaller reservoirs in the Umatilla River and Walla Walla River basins again reduced flooding downstream. McKay Reservoir, which controls flows from 8 percent of the 2,290-square-mile Umatilla River basin, stored practically all inflow until after the main peak on the Umatilla River had passed the mouth of McKay Creek. The outflow from the reservoir was then gradually increased, although storage space was available throughout the flood period. The maximum inflow to McKay Reservoir was 7,400 cfs January 30, but the maximum outflow was only 1,320 cfs February 2. Storage in Mill Creek flood-control reservoir in the Walla Walla River basin reduced flooding on lower Mill Creek. Lake Billy Chinook in the Deschutes River basin was full at the time of the late January flood, but because runoff from the flood was not outstanding, storage space was not needed. Prineville Reservoir stored most of the runoff from the Crooked River basin.

WILLAMETTE RIVER BASIN

Reservoir storage and flow regulation in the seven major flood-control reservoirs in the Willamette River basin shown below substan-

Reservoir	*River*	*December 1964*	*Storage (in thousands of acre-ft.)*
Hills Creek	Middle Fork Willamette	21–25	179
Lookout Point	do	21–26	332
Cottage Grove	Coast Fork Willamette	20–23	34
Dorena	Row	20–23	86
Cougar	McKenzie	21–26	146
Fern Ridge	Long Tom	20–27	111
Detroit	North Santiam	21–26	312

tially reduced the peak discharges of the December 1964 flood. The reservoirs stored 1,200,000 acre-feet of water during the critical period of the flood.

The reservoir storage provided almost complete control of flows at the time of the peak inflows in December, effecting very substantial reductions in the peak discharges and flood damage downstream from the reservoirs. Special releases of water were necessary, however, near the end of the flood period so that the storage space could be efficiently utilized. The resulting maximum outflows averaged about 27 percent of the peak inflows and occurred several days after the principal uncontrolled peaks in the basin.

The flood in late January 1965 was moderate in the Willamette River basin; much of the basin was not in the area of major flooding. The seven flood-control reservoirs stored about 550,000 acre-feet of water during this flood period.

The reductions in the maximum stages and discharges at selected stations in the Willamette River basin that resulted from storage and regulation are shown in table 18. Data are given on the estimated maximum flow without regulation, the peak discharge as observed, and the reductions in both stage and discharge achieved during the floods of December 1964 and January 1965. The natural maximum flows in the region generally occurred December 22 or 23; the regulated peak flows occurred from a few hours to several days later. In January the normal peakflows occurred January 28 or 29, with comparable lag in the regulated peakflows.

Channel storage was a factor in reducing peak discharge in the lower reaches of the Willamette River, as it was in December 1955. Although the peak discharge in the Willamette River in December 1964 showed a net gain between Salem and Wilsonville, the attenuation of the peak by channel storage partly offset the effect of inflow from streams in the intervening area. In late January the peak discharge at the downstream station at Wilsonville was less than that at Salem, despite inflow of about 20,000 cfs between the two sites at the time of the peak.

The regulated peak discharge in the Willamette River at Oregon City in December 1964 was 40 percent greater than in December 1955, and the estimated unregulated flow was 64 percent greater; the 1964 flows, however, were slightly less than the discharge during the legendary flood of 1861, as shown by records at Albany and Salem. Though the storage regulation did not maintain the controlled streams within their banks, the flood-stage reductions prevented very serious flooding in populated areas. In the Portland area the Willamette River basin flood-control reservoirs reduced the

TABLE 18.—*Reduction of December 1964 and January 1965 stages and flood discharges by storage and regulation in the Willamette River basin, Oregon*

[Compiled by U.S. Army Corps of Engineers, Portland District]

Stream	Station	December 1964				January 1965			
		Estimated unregulated peak discharge (cfs)	Observed regulated peak discharge (cfs)	Reduction in peak		Estimated unregulated peak discharge (cfs)	Observed regulated peak discharge (cfs)	Reduction in peak	
				Stage (ft)	Discharge (cfs)			Stage (ft)	Discharge (cfs)
Middle Fork, Willamette River	Jasper	135,000	43,500	8.6	91,500	59,800	22,400	5.3	37,400
Coast Fork, Willamette River	Goshen	73,000	[1]30,000	5.4	43,000	25,500	9,500	6.2	16,000
McKenzie River	Coburg	114,000	[1]85,000	2.6	29,000	77,000	[1]65,700	1.4	11,300
Willamette River	Eugene	193,000	60,400	14.8	132,600	75,700	28,600	8.9	47,100
Do	Harrisburg	280,000	[1]128,000	3.2	152,000	144,100	89,100	3.7	55,000
Long Tom River	Monroe	30,800	[1]10,900	1.5	19,900	13,700	6,100	2.2	7,600
Willamette River	Albany	320,000	186,000	6.3	134,000	162,300	[1]110,000	5.0	52,300
North Santiam River	Mehama	134,000	58,400	6.2	75,600	48,800	22,300	3.5	26,500
Santiam River	Jefferson	255,000	197,000	1.9	58,000	161,600	[1]140,200	.8	21,400
Willamette River	Salem	472,000	[1]309,000	7.5	163,000	283,400	248,000	2.3	35,400
Do	Wilsonville	492,000	[1]332,000	8.1	160,000	255,800	223,000	3.6	32,800
Do	Oregon City (upper).	545,000	390,000	3.4	155,000	....	....	....	....
Do	Oregon City (lower).	545,000	390,000	10.7	155,000	....	....	....	....
Do	Portland	585,000	[1]440,000	4.6	145,000	....	....	....	....

[1]Preliminary figures; changed slightly in final computations, as shown in table 19 and in part 2, "Streamflow and Sediment Data," of this report.

flood stage 4.6 feet. Flood regulation in the Columbia River provided about 1 foot additional reduction. Thus, as estimated by the Corps of Engineers, without the available storage regulation the maximum stage at Portland would have been 36 feet (4.6 feet higher than the regulated stage) and would have caused a major catastrophe.

COASTAL OREGON

Surface storage regulation had little effect on flood peaks in coastal Oregon; there are no large reservoirs in the area. Emigrant Reservoir (capacity, 39,000 acre-ft) on Emigrant Creek near Ashland, which provides regulation for 64 square miles in the Rogue River basin, stored about 15,000 acre-feet of water during the critical period of the flood, December 17–25. This storage helped reduce local flooding from Bear Creek near Medford, but the effect on river flows downstream was minor because the regulated basin represents only about 1 percent of the Rogue River drainage area. There are no other reservoirs with flood-storage space in the coastal Oregon region.

Infiltration of rainwater and snowmelt into the porous volcanic material in the upper Umpqua River and Rogue River basins in the vicinity of Crater Lake is believed to have substantially reduced flood peaks in those basins. This natural reservoir absorbs large quantities of water and releases it gradually as ground-water outflow during ensuing weeks and months and thus sustains relatively high flows in streams during the low-water season.

FLOOD FREQUENCY

The recurrence interval, or return period, of a flood of a given magnitude is the average interval of time within which the given flood will be exceeded once by the annual maximum discharge. The recurrence interval is inversely related to the chance of a specific flood discharge being exceeded in any one year. Thus, a flood with a 50-year recurrence interval would have 1 chance in 50 of being exceeded in any one year. Recurrence intervals are average figures based on historical data; because the occurrence of floods is erratic, the 50-year flood may not necessarily occur in any given 50-year period, or floods of this magnitude may occur several times during that period. A similar relation is true for a flood of any given recurrence interval.

Recurrence intervals for most of the maximum discharges of the floods in December 1964 and January 1965 (table 19) were determined from the flood-frequency relations developed in Water-Supply Papers 1684 through 1689 on magnitude and frequency of floods in the United States, Parts 10–14. The recurrence interval is not given for regulated streams unless adjustments can be made for the regulation, nor for discharges exceeding that of the 50-year flood. In the latter case, the ratio of the 1964–65 discharge to the 50-year flood discharge is given and footnoted as such.

DETERMINATION OF FLOOD DISCHARGES

Discharge at a gaging station is determined usually by development of a stage-discharge relation from current-meter measurements made at various stages and by application of this relation to records of stage. The record of stage is obtained generally from a water-stage recorder installation that provides a continuous graphic or punch-tape record. The reliability of the stage-discharge relation (rating curve) depends on the extent to which the discharge may be defined by measurements over the full range in stage. Short extensions of rating curves are made usually by logarithmic plotting, or on the basis of slope-conveyance studies or velocity-area studies, or by use of other measurable hydraulic factors.

The floods of December 1964 and January 1965 were of such broad areal extent and severity that current-meter measurements could not be obtained at many gaging stations at or near the time of the maximum discharge. Measuring facilities such as cableways and bridges were destroyed, and access roads and bridges were flooded or isolated by washouts. On some smaller streams the durations of the principal flood peaks were too short to permit measurement. The sites requiring flood measurements during the period of the major peak were far too numerous for direct measurement of discharge by current meter by the trained personnel available. In many instances, however, several substantial peaks occurred during the flood period as a result of continuing rains in December and the storms in January. Current-meter measurements obtained during the later peaks were effective in the definition of the stage-discharge relations at many stations.

At many gaging stations no high-water current-meter measurements were made during the floods, or the previous measurements were inadequate to define the extreme flows; therefore, the peak discharge was obtained by slope-area, contracted-opening, culvert, flow-over-dam, or other types of indirect measurements. At several miscellaneous sites where high runoff occurred, the peak flow was determined by indirect measurement.

Indirect measurements were made at more than 200 sites throughout the area covered by this report. Peak discharge at an additional several hundred crest-stage stations was determined by computation of flow through culverts. These indirect measurements were based on field surveys of high-water profiles, channel geometry, and hydraulic structure geometry and were computed in accordance with established hydraulic principles. They are indirect only in the sense that the data are collected subsequent to the passage of the maximum flow. General descriptions of the indirect-measurement methods used by the Geological Survey are given in Water-Supply Papers 773–E, 798, 816, 843, and 888; more detailed information on techniques is available in publications and reports of the Geological Survey, such as selected chapters in the series "Techniques of Water-Resources Investigations of the United States Geological Survey."

SUMMARY OF FLOOD STAGES AND DISCHARGES

Maximum stages and discharges at 1,240 gaging stations, partial-record stations, reservoir stations, and miscellaneous sites in the area covered by this report are summarized in table 19. The reference numbers in the table correspond to those on the location maps and to the numbers used for identification in Water-Supply Paper 1866–B. As an added means of identification, each gaging station is listed with its permanent network-station number in the same downstream order used in the annual streamflow reports of the Geological Survey. Most of the miscellaneous sites are identified in a similar manner.

The derivation of the maximum data is explained in the station description for each site given in part 2 of this report (WSP 1866–B). The maximum flow values given in table 19 for streamflow sites are for flows that passed the gaging station or measurement site, with no adjustments for storage, regulation, or diversion. For all the reservoir stations, the maximum stage and contents are given; for some of the stations the computed peak inflow and, occasionally, the computed outflow are given also (station 159, table 19).

In table 19 the first column under maximum floods shows the period of known floods prior to December 1964. This period does not necessarily correspond to that in which continuous records of discharge were obtained, and for some stations the record extends back to an earlier date. More than one period of record is shown for some stations. Separate time periods are given when they can be associated with a specific flood occurring prior to the start of continuous records or with a maximum stage, even though the corresponding discharge is not known. Under the heading "Maximum flood previously known," maximums during the period of gaging-station operation are listed first, and available data on floods outside this period are given on the line below (station 451, table 19). At stations where the maximum discharge did not occur simultaneously with the maximum stage, the maximums are given on separate lines (station 22, table 19).

The last column shows the average interval of time in which the peak discharge in December 1964 and January 1965 can be expected to be exceeded once. Whenever the peak discharge exceeds that of the 50-year flood (the maximum defined by the frequency curve), the ratio of the peak discharge to the 50-year flood is shown.

TABLE 19.—*Summary of flood stages and discharges*

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		The Great Basin									
		Carson River basin:									
1	10-3045	Silver Creek below Pennsylvania Creek, near Markleeville, Calif.	19.6	1946–64	1963	[1]5.28	2,220	Dec. 23	6.63	1,600	29
2	10-3081	Millberry Creek at Marlkeeville, Calif.	5.10	1963–64	1963	17.1	291	Dec. 22	8.42	81.2	
3	10-3082	East Fork Carson River below Markleeville Creek, near Markleeville, Calif.	276	1960–64	1963	8.21	15,100	Dec. 23	7.20	9,100	12
4	10-3088	Bryant Creek near Gardnerville, Nev.	31.5	1961–64	1963	6.40	975	Jan. 23	1.38	52	
5	10-3090	East Fork Carson River near Gardnerville, Nev.	341	1890–93, 1900–1906, 1908–10, 1917, 1924–29, 1935–37, 1939–64.	1955	11.88	17,600	Dec. 23	8.13	8,230	[2].72
6	10-3100	West Fork Carson River at Woodfords, Calif.	65.6	1900–1907, 1910–11, 1938–64.	1963	9.0	4,890	Dec. 23	6.70	3,100	[2].77
7	10-3105	Clear Creek near Carson City, Nev.	15	1948–64	1963	2.29	170	([3])	1.47	58	[2].15
8	10-3110	Carson River near Carson City, Nev.	876	1939–64	1955	15.0	30,000	Dec. 25	9.82	8,740	[2].36
9	10-3120	Carson River near Fort Churchill	1,450	1911–64	1963	10.83	15,300	Dec. 26	7.96	7,220	[2].83
					1965	11					
		Pyramid and Winnemucca Lakes basin:									
10	10-3366	Upper Truckee River near Meyers, Calif.	33.1	1960–64	1963	12.41	2,550	Dec. 23	12.32	2,490	32
11	10-3366.35	Lake Tahoe tributary near Meeks Bay, Calif.	.64	1963–64	1963	13.54	43	Dec. 22	12.33	22	
12	10-3366.6	Blackwood Creek near Tahoe City, Calif.	11.2	1960–64	1963	[1]8.90	2,000	Dec. 22 or 24	([3])	2,100	[2]1.71
13	10-3367.8	Trout Creek near Tahoe Valley, Calif.	36.7	1960–64	1963	11.14	535	Dec. 24	10.51	411	[2].13
14	10-3370	Lake Tahoe at Tahoe City, Calif.	506	1900–64	1907	[4]6,231.26	[5]1,011,100	Jan. 28–31	[4]6,227.24	[5]516,200	
15	10-3375	Truckee River at Tahoe City, Calif.	507	1895–96, 1900–64.	1958	[1,7]7.34	[6]1,870	Jan. 29, 30, 31	4.81	[6,8]452	[2].23
16	10-3379	Truckee River tributary near Truckee, Calif.	1.06	1963–64	1963	20.8	220	Dec. 22	18.23	90	
17	10-3380	Truckee River near Truckee, Calif.	552	1944–64	1963		[6]11,000	Dec. 23	8.70	[6]9,500	[2]1.30
					1958	[7]9.69					

18	10-3385	Donner Creek at Donner Lake, near Truckee, Calif.	14.5	1909-10, 1929-53, 1955-57, 1958-64.	1950	...	[6,8] 700	Dec. 25	4.55	[6] 695	...
					1962	[7] 4.15	...	...	...	...	...
19	10-3392	Middle Martis Creek near Truckee, Calif.	2.82	1964	...	...	...	Dec. 22	12.08	40	...
20	10-3394	Martis Creek near Truckee, Calif.	40.8	1958-64	1963	6.16	1,880	Dec. 23	5.04	1,040	3
21	10-3399	Alder Creek near Truckee, Calif.	7.36	1958-64	1963	5.86	730	Dec. 23	[9] 4.80	680	...
22	10-3405	Prosser Creek near Boca, Calif.	53.5	1942-64	1955	...	4,560	Dec. 25	6.28	[6] 1,610	...
					1950	11.0	...	...	...	...	...
23	10-3420	Little Truckee River near Hobart Mills, Calif.	36.6	1946-64	1963	[1] 7.76	7,910	Dec. 23	8.70	7,760	[2] 2.41
24	10-3435	Sagehen Creek near Truckee, Calif.	10.8	1953-64	1963	4.64	765	Dec. 23	4.32	528	6
25	10-3444	Little Truckee River above Boca Reservoir, near Boca, Calif.	146	1903-10, 1939-64.	1963	9.00	13.300	Dec. 23	6.95	10,500	[2] 1.09
26	10-3444.9	Boca Reservoir at Boca, Calif.	172	1939-64	1955	[4] 5,605.55	[5] 41,440	Dec. 25	[4] 5,593.10	[5] 30,070	...
27	10-3445	Little Truckee River at Boca, Calif.	172	1890, 1911-15, 1939-64.	1955	(3)	[6] 8,800	Dec. 25	5.59	[6] 1,990	...
28	10-3460	Truckee River at Farad, Calif.	932	1899-1964	1950	14.5	[6] 17,500	Dec. 23	11.67	[6] 12.000	[2] .70
29	10-3476	Hunter Creek near Reno, Nev.	11.5	1961-64	1963	6.93	986	Dec. 22	2.48	117	<2
30	10-3478	Peavine Creek near Reno, Nev.	2.34	1963-64	1963	.96	29	Dec. 23	1.30	30	...
31	10-3480	Truckee River at Reno, Nev.	1,067	1906-21, 1925-26, 1930-35, 1943, 1946-64.	1955	...	[6] 20,800	Dec. 23	11.45	[6] 11,300	[2] .58
					1950	13.83	...	...	...	...	...
32	10-3489	Galena Creek near Steamboat, Nev.	8.5	1961-64	1963	2.26	472	Dec. 22	(3)	315	3
				1956	1956	(3)	4,730	...	...	...	...
33	10-3493	Steamboat Creek at Steamboat, Nev.	123	1961-64	1963	5.44	1,000	Dec. 23	4.07	461	22
34	10-3497	Whites Creek near Steamboat, Nev.	8.02	1961-64	1963	2.54	135	Dec. 23	2.21	66	...
35	10-3500	Truckee River at Vista, Nev.	1,429	1899-1908, 1932-54, 1958-64.	1963	16.76	[6] 21,300	Dec. 23	13.51	[6] 11,700	...
				1955	1955	[1] 17.04	...	...	...	...	...
36	10-3516	Truckee River below Derby Dam, near Wadsworth, Nev.	1,670	1909-10, 1916-64.	1963	14.26	[6] 18,400	Dec. 23	12.30	[6] 11,400	...
37	10-3517	Truckee River near Nixon, Nev.	1,869	1955-64	1963	14.39	[6] 14,400	Dec. 24	11.08	[6] 9,950	...
		Honey Lake basin:									
38	10-3539.85	Washoe Creek near Hallelujah Junction, Calif.	1.53	1963-64	...	...	...	Dec. 22	3.55	1.8	...
39	10-3547	Mill Creek at Milford, Calif.	2.26	1963-64	1964	2.37	2.1	Jan. 5	3.59	23	...
40	10-3563	West Fork Willard Creek tributary near Westwood, Calif.	.83	1963-64	1963	5.26	45	Dec. 22	5.08	51	...
41	10-3565	Susan River at Susanville, Calif.	184	1900-05, 1913, 1917-21, 1950-64.	1963	6.78	[6] 3,900	Dec. 22	7.30	[6] 5,100	[2] 1.26
42	10-3584.7	Willow Creek tributary near Susanville, Calif.	3.08	1962-64	1963	4.90	97	Dec. 22	4.34	72	...

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		The Great Basin—Continued									
		Honey Lake and basin—Continued									
43	10-3585	Willow Creek near Susanville, Calif.	[10] 90.0	1950–64	1963	5.59	816	Dec. 23	5.43	744	3
44	10-3591	Shaffer Creek near Litchfield, Calif.	5.63	1963–64	....	....	....	Dec. 23	5.06	28	....
		Eagle Lake basin:									
45	10-3593	Pine Creek near Susanville, Calif.	226	1960–64	1963	5.37	806	Dec. 23	4.68	559	<2
46	10-3593.5	Eagle Lake tributary near Susanville, Calif.	.91	1962–64	1963	5.14	21	Jan. 23	4.06	8.8	....
		Madeline Plains basin:									
47	10-3594.9	Madeline Plains tributary near Ravendale, Calif.	.062	1962–64	1962	3.92	8.3	Dec. 23	4.05	9.4	....
48	10-3595.1	Whiskey Creek near Termo, Calif.	4.56	1962–64	1963	14.15	132	Dec. 22	12.86	104	....
		Surprise Valley basin:									
49	10-3602.3	Eagle Creek at Eagleville, Calif.	6.36	1961–64	1963	....	[8] 60	Dec. 23	4.50	800	....
50	10-3609	Bidwell Creek below Mill Creek, near Fort Bidwell, Calif.	25.6	1960–64	1963	4.08	197	Dec. 24	[9] 5.64	682	50
		Warner Lakes basin:									
51	10-3660	Twentymile Creek near Adel, Oreg.	194	1910–19, 1921–22, 1940–64.	1955	14.80	3,260	Dec. 23	16.1	3,670	[2] 1.06
52	10-3700	Camas Creek near Lakeview, Oreg.	63	1912–15, 1949–64.	1955	5.63	1,630	Dec. 23	7.32	3,190	[2] 2.26
53	10-3710	Drake Creek near Adel, Oreg.	67	1915, 1922–23, 1949–64.	1963	5.69	4,050	Dec. 23	8.4	6,210	[2] 4.23
54	10-3715	Deep Creek above Adel, Oreg.	249	1922–23, 1929–64.	1963	8.93	5,500	Dec. 23	10.64	9,420	[2] 2.23
55	10-3785	Honey Creek near Plush, Oreg.	170	1909–15, 1921–22, 1930–64.	1963	[1] 10.46	6,210	Dec. 23	13.4	11,000	[2] 3.54
		Abert Lake basin:									
56	10-3840	Chewaucan River near Paisley, Oreg.	275	1912–21, 1924–64.	1955	4.93	[1] 3,260	Dec. 22	8.35	6,490	[2] 1.42
				1909	1909	....	4,000	....	....	....	....

		Silver Lake basin:									
57	10-3900	Silver Creek near Silver Lake, Oreg.	180	1905-07, 1909-64.	1907	10.08	1,800	Dec. 22	10.3	1,650	6
58	10-3904	Bridge Creek near Silver Lake, Oreg.	10.6	1964				Dec. 22	13.10	203	8
		Malheur and Harney Lakes basin:									
59	10-3935	Silvies River near Burns, Oreg.	934	1903-06, 1908-64.	1952	15.2	4,960	Dec. 23	14.16	3,130	13
60	10-3960	Donner und Blitzen River near Frenchglen, Oreg.	200	1911-21, 1929-30, 1937-64.	1953	6.29	2,750	Dec. 23	6.24	2,690	[2] 1.23
61	10-3970	Bridge Creek near Frenchglen, Oreg.	30	1911-16, 1930, 1937-64.	1953	2.73	301	Dec. 22	2.05	106	<2
62	10-4030	Silver Creek near Riley, Oreg.	228	1951-64	1952	6.65	1,300	Dec. 22	7.49	1,810	[2] 1.27
		San Joaquin River and Sacramento River basins									
		San Joaquin River basin:									
63	11-2260	North Fork San Joaquin River below Iron Creek, Calif.	35.5	1920-28, 1951-64.	1956	8.15	3,860	Dec. 23	7.60	2,490	9
64	11-2265	San Joaquin River at Miller Crossing, Calif.	249	1921-28, 1951-64.	1955	21.28	16,600	Dec. 23	19.00	9,680	10
65	11-2296	Florence Lake near Big Creek, Calif.	171	1925-64	1932	[4] 7,329.14	[5] 66,000	Dec. 29	[4] 7,255.29	[5] 9,100	
66	11-2300	South Fork San Joaquin River near Florence Lake, Calif.	171	1921-64	1940	15.38	[6] 4,320	Dec. 23	8.95	[6] 8.2	
67	11-2305	Bear Creek near Lake Thomas A. Edison, Calif.	52.5	1921-64	1956	7.12	1,680	Dec. 23	5.58	738	4
68	11-2310	Lake Thomas A. Edison near Big Creek, Calif.	90.0	1954-64	1958	[4] 7,642.95	[5] 125,900	Jan. 8	[4] 7,596.29	[5] 48,700	
69	11-2315	Mono Creek below Lake Thomas A. Edison, Calif.	92.5	1921-64	1938	8.62	1,760	Jan. 25	6.45	[6] 445	
70	11-2325	Jackass Creek near Bass Lake, Calif.	12.1	1921-28, 1951-64.	1955	11.37	786	Dec. 23	10.17	554	14
71	11-2345	Chiquito Creek near Bass Lake, Calif.	60.1	1921-28, 1951-64.	1955	16.38	8,630	Dec. 23	10.84	2,670	9
72	11-2347	Mammoth Pool Reservoir near Big Creek, Calif.	995	1959-64	1963	[4] 3,332.93	[5] 123,200	Dec. 28	[4] 3,296.26	[5] 86,300	
73	11-2347.6	San Joaquin River above Shakeflat Creek, near Big Creek, Calif.	1,003	1959-64	1962	11.90	[6] 5,780	Jan. 6	3.53	[6] 96	
74	11-2360	Huntington Lake near Big Creek, Calif.	80.5	1913-64	1926	[4] 6,950.92	[5] 90,500	Jan. 31	[4] 6,911.23	[5] 41,500	
75	11-2370	Big Creek below Huntington Lake, Calif.	81.1	1925-64	1925	11.3	[6] 2,040	Dec. 23	2.93	[6] 21	
76	11-2375	Pitman Creek below Tamarack Creek, Calif.	22.9	1927-64	1955	11.20	3,670	Dec. 24	6.81	634	8
77	11-2395	Shaver Lake near Big Creek, Calif.	29.1	1909-64	1946	[4] 5,370.25	[5] 135,900	Jan. 14	[4] 5,312.19	[5] 37,000	
78	11-2420	San Joaquin River above Willow Creek, near Auberry, Calif.	1,295	1951-64	1955	54.2	[6] 73,200	Dec. 23	5.90	[6] 192	

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Maximum flood previously known: Year	Maximum flood previously known: Gage height (ft)	Maximum flood previously known: Discharge (cfs)	Maximum December 1964 and January 1965: Day	Maximum December 1964 and January 1965: Gage height (ft)	Maximum December 1964 and January 1965: Discharge: Cfs	Maximum December 1964 and January 1965: Discharge: Recurrence interval (yr)
		San Joaquin River and Sacramento River basins—Continued									
		San Joaquin River basin—Continued									
79	11-2434	Bass Lake near Bass Lake, Calif.	50.4	1911-64	1923	[4] 3,376.8	[5] 45,960	Jan. 24	[4] 3,367.2	[5] 35,160	
80	11-2440	North Fork Willow Creek near Bass Lake, Calif.	50.8	1940-64	1941	5.85	[6] 847	Jau. 24	3.14	[6] 78	
81	11-2465	Willow Creek at mouth, near Auberry, Calif.	130	1952-64	1955	28.5	[6] 15,700	Dec. 23	15.70	[6] 4,940	
82	11-2470	San Joaquin River below Kerckhoff powerhouse, near Prather, Calif.	1,481	1910-14, 1936-37, 1942-64.	1955	51.0	[6] 92,200	Dec. 23	20.76	[6] 8,750	
83	11-2501	Millerton Lake at Friant, Calif.	1,637	1941-64	1963	[4] 579.56	[11] 528,200	Jan. 23	[4] 562.14	[11] 446,000	
84	11-2510	San Joaquin River below Friant, Calif.	1,675	1907-41	1937	[1] 23.8	[6] 77,200	Jan. 7	2.62	[6] 136	
				1942-64[6]	1943	(3)	[6] 11,200				
85	11-2555	Panoche Creek below Silver Creek, near Panoche, Calif.	293	1949-53, 1958-64.	1958	7.01	5,090	Jan. 7-8	1.86	2.4	(3)
86	11-2571	Miami Creek near Oakhurst, Calif.	10.6	1960-64	1963	9.08	1,140	Dec. 23	7.11	549	(3)
87	11-2575	Fresno River near Knowles, Calif.	133	1911-13, 1915-64.	1955	11.52	13,300	Dec. 23	5.59	3,000	3
88	11-2577	Picayune Creek near Coarsegold, Calif.	8.17	1959-64	1962	5.12	216	Jan. 6	4.55	174	
89	11-2580	Fresno River near Daulton, Calif.	258	1941-64	1955	12.64	17,500	Dec. 23	6.73	3,460	2
90	11-2588	East Fork Chowchilla River near Ahwahnee, Calif.	57.8	1957-64	1963	10.34	3,710	Dec. 23	9.85	3,190	8
91	11-2589	West Fork Chowchilla River near Mariposa, Calif.	33.6	1957-64	1958	8.67	3,590	Dec. 23	7.70	2,260	16
92	11-2589.2	Middle Fork Chowchilla River near Nipinnawassee, Calif.	13.6	1958-64	1963	10.10	1,280	Dec. 23	8.56	1,010	28
93	11-2590	Chowchilla River at Buchanan damsite, near Raymond, Calif.	235	1921-23, 1930-64.	1955	16.50	30,000	Dec. 23	[9] 11.15	8,380	11
94	11-2602	Bear Creek near Catheys Valley, Calif.	24.9	1958-64	1963	10.07	2,520	Jan. 7	9.97	2,490	39
95	11-2602.1	Bear Creek tributary near Catheys Valley, Calif.	1.73	1959-64	1962	22.64	63	Jan. 6	[7] 26.04	162	
96	11-2602.25	Burns Creek near Hornitos, Calif.	26.7	1958-64	1962	10.66	9,200	Jan. 6	9.30	5,900	(3)
97	11-2604.8	Mariposa Creek near Catheys Valley, Calif.	65.7	1958-64	1958	11.62	7,180	Dec. 23	10.81	5,200	(3)
98	11-2610	Salt Slough near Los Banos, Calif.		1940-64	1941		[8] 2,420	Jan. 9	4.18	180	
99	11-2615	San Joaquin River at Fremont Ford Bridge, Calif.	7,619	1944-64	1958	67.37	[6] 5,910	Jan. 10	64.62	[6] 3,120	
100	11-2628	Los Banos Creek near Los Banos, Calif.	159	1955-64	1955	[9] 12.07	11,400	Dec. 23	2.92	716	(3)
101	11-2629.5	Wolf Creek near Volta, Calif.	2.82	1958-64	1963	5.70	207	Jan. 20	3.17	16	

102	11-2630.5	Garzas Creek near Gustine, Calif.	51.2	1959–64	1963	6.22	1,770	Dec. 28	2.07	52	<2
103	11-2645	Merced River at Happy Isles Bridge, near Yosemite, Calif.	181	1915–64	1955	12.73	9,860	Dec. 23	11.50	9,240	9
104	11-2665	Merced River at Pohono Bridge, near Yosemite, Calif.	321	1916–64	1955	21.52	23,400	Dec. 23	16.96	18,000	13
105	11-2673	South Fork Merced River at Wawona, Calif.	100	1955–64	1955	12	15,000	Dec. 23	[9] 9.83	9,030	14
106	11-2677	Strawberry Creek near Wawona, Calif.	1.05	1962–64	1963	22.57	34	Dec. 23	23.87	46	
107	11-2680	South Fork Merced River near El Portal, Calif.	241	1950–64	1955	18.70	46,500	Dec. 23	13.62	14,200	8
108	11-2685	Merced River at Bagby, Calif.	911	1922–64	1955	26.80	92,500	Dec. 23	[9] 14.79	33,800	6
109	11-2693	Maxwell Creek at Coulterville, Calif.	17.0	1959–64	1960	5.73	1,720	Dec. 22	5.71	1,770	20
110	11-2693.5	North Fork Blacks Creek near Coulterville, Calif.	2.19	1962–64	1963	6.85	472	Jan. 6	6.12	203	
111	11-2695	Lake McClure at Exchequer, Calif.	1,037	1926–64	1950	[4] 710.5	[11] 290,800	Jan. 7	[4] 700.9	[11] 265,300	
112	11-2710	Merced River at Merced Falls, Calif.	1,052	1901–13, 1915–64.	1911	[1] 23.3	47,000	Jan. 7	15.54	[6] 17,100	
113	11-2713	Hayward Creek near La Grange, Calif.	3.96	1959–64	1963	15.00	520	Dec. 23	15.23	661	
114	11-2725	Merced River near Stevinson, Calif.	1,273	1940–64	1950	[4] 73.79	[6] 13,600	Jan. 8	[4] 72.09	[6] 11,000	
115	11-2730	Merced River Slough near Newman, Calif.		1941–64	1958		[8] 7,770	Jan. 8	[4] 65.23	805	
116	11-2740	San Joaquin River near Newman, Calif.	9,524	1912–64	1938	[4] 65.81	[6,12] 33,000	Jan. 10	[4] 62.69	[6] 11,300	
117	11-2745	Orestimba Creek near Newman, Calif.	134	1932–64	1958	[1] 6.57	10,200	Jan. 6	6.20	560	2
118	11-2746	Del Puerto Creek tributary No. 1 near Patterson, Calif.	.71	1958–64	1963	8.53	20	Dec. 22	7.94	9.0	
119	11-2747.3	Budd Creek near Tuolumne Meadows, Calif.	2.94	1962–64	1963	6.59	134	Dec. 23	6.48	129	
120	11-2750	Falls Creek near Hetch Hetchy, Calif.	46.0	1915–64	1950, 1955	9.0	6,660	Dec. 23	8.66	5,490	22
121	11-2755	Hetch Hetchy Reservoir at Hetch Hetchy, Calif.	455	1923–64	1950	[4] 3,810.4	[5] 369,100	Jan. 17–18	[4] 3,756.7	[5] 267,800	
122	11-2765	Tuolumne River near Hetch Hetchy, Calif.	457	1910–64	1943	13.90	[6] 12,900	Dec. 14	9.17	[6] 2,600	
123	11-2772	Cherry Lake near Hetch Hetchy, Calif.	117	1956–64	1957	[4] 4,700.6	[5] 269,300	Jan. 25	[4] 4,607.2	[5] 122,200	
124	11-2773	Cherry Creek below Cherry Valley Dam, near Hetch Hetchy, Calif.	118	1956–64	1958	9.95	[6] 3,830	Dec. 3	6.67	[6] 855	
125	11-2775	Lake Eleanor near Hetch Hetchy, Calif.	78.1	1918–64	1937	[4] 4,663.4	[5] 31,000	Dec. 24	[4] 4,662.7	[5] 28,800	
126	11-2780	Eleanor Creek near Hetch Hetchy, Calif.	78.4	1909–64	1950	14.95	[6] 11,700	Dec. 24	9.94	[6] 6,920	
127	11-2783	Cherry Creek near Early Intake, Calif.	226	1956–64	1963	14.50	[6] 16,500	Dec. 24	12.12	[6] 8,660	
128	11-2784	Cherry Creek below Dion R. Holm powerhouse, near Mather, Calif.	234	1963–64	1963	9.96	[6] 2,130	Dec. 24	13.55	[6] 8,530	
129	11-2793	Smoky Jack Creek near Yosemite, Calif.	.68	1962–64	1963	9.03	101	Dec. 23	8.22	78	
130	11-2810	South Fork Tuolumne River near Oakland Recreation Camp, Calif.	87.0	1923–64	1955	10.9	11,900	Dec. 23	6.27	2,120	3
131	11-2820	Middle Tuolumne River at Oakland Recreation Camp, Calif.	73.5	1916–64	1955	[9] 11.05	4,920	Dec. 24	7.06	1,430	2
132	11-2831	Lily Creek near Pinecrest, Calif.	11.9	1963–64	1963	11.7	2,030	Dec. 23	10.77	1,700	(3)
133	11-2832	Bell Creek near Pinecrest, Calif.	9.11	1963–64	1963	8.79	1,410	Dec. 23	7.54	934	
134	11-2835	Clavey River near Buck Meadows, Calif.	144	1959–64	1963	[9] 21.40	19,200	Dec. 23	18.60	12,400	19

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		San Joaquin River and Sacramento River basins—Continued									
		San Joaquin River basin—Continued									
135	11-2845	Big Creek near Groveland, Calif.	24.7	1931–33, 1959–64.	1963	[9] 7.71	4,530	Jan. 6	5.70	1,830	10
				1955	1955	7.6	4,300				
136	11-2847	North Fork Tuolumne River near Long Barn, Calif.	23.1	1955–64	1955	9.8	2,560	Dec. 23	[9] 6.39	1,060	5
137	11-2848	Sugarpine Creek at Long Barn, Calif.	1.38	1962–64	1963	10.82	107	Dec. 24	11.45	139	
138	11-2850	North Fork Tuolumne River above Dyer Creek, near Tuolumne, Calif.	69.2	1958–64	1963	5.79	4,130	Dec. 23	[9] 5.16	2,990	5
				1955	1955	10.7	(3)				
139	11-2863	Curtis Creek tributary near Standard, Calif.	.26	1962–64	1963	17.51	36	Dec. 23	18.08	52	
140	11-2865	Woods Creek near Jacksonville, Calif.	97.2	1925–64	1955	14.66	14,400	Dec. 23	12.40	8,650	41
141	11-2875	Don Pedro Reservoir near La Grange, Calif.	1,530	1924–64	1937	[4] 606.1	[11] 292,100	Dec. 28	[4] 577.2	[11] 205,400	
142	11-2880	Tuolumne River above La Grange Dam, near La Grange, Calif.	1,532	1895–1964	1950	43.8	[6] 61,000	Jan. 7	13.90	[6] 8,450	
143	11-2900	Tuolumne River at Modesto, Calif.	1,884	1895–96, 1940–64.	1950	[4] 69.19	[6] 57,000	Jan. 7	[4] 55.35	[6] 11,100	
144	11-2920	Middle Fork Stanislaus River at Kennedy Meadows, near Dardanelle, Calif.	47.5	1938–64	1950	6.66	[6] 1,700	Dec. 23	5.96	[6] 1,220	
145	11-2925	Clark Fork Stanislaus River near Dardanelle, Calif.	67.5	1950–64	1950	11.88	4,350	Dec. 23	10.08	3,020	9
146	11-2926	Donnell Lake near Dardanelle, Calif.	230	1957–64	1963	4,917.3	[11] 64,900	Dec. 24	4,903.4	[11] 59,100	
								Dec. 23		[13] 14,200	
147	11-2926.8	Cascade Creek near Pinecrest, Calif.	4.97	1962–64	1963	[9] 10.35	532	Dec. 24	[9] 10.21	519	
148	11-2927	Middle Fork Stanislaus River of Hells Half Acre Bridge, near Pinecrest, Calif.	287	1905–64	1955	23.0	26,600	Dec. 24	[9] 13.64	[6] 10,200	
149	11-2928	Beardsley Lake near Strawberry, Calif.	309	1957–64	1957	3,398.2	[11] 93,700	Dec. 27	3,370.7	[11] 79,[illegible]	
								Dec. 24		[13] 11,[illegible]00	
150	11-2929	Middle Fork Stanislaus River below Beardsley Dam, Calif.	316	1956–64	1958	10.48	[6] 5,860	Dec. 27	8.86	[6] 3,220	
151	11-2930	Middle Fork Stanislaus River at Sand Bar Flat, near Avery, Calif.	325	1905–57	1955	20.2	26,000	Dec. 27	9.34	[6] 3,190	
				1957–64	1958	11.60	6,030				
152	11-2933	North Fork Stanislaus River tributary near Lake Alpine, Calif.	.09	1962–64	1963	13.04	23	Dec. 23	13.20	27	

153	11-2935	North Fork Stanislaus River below Silver Creek, Calif	27.8	1952-64	1955	9.17	1,370	Dec. 24	11.16	2,780	
				1950	1950	11.17	2,790				
154	11-2940	Highland Creek below Spicer Meadows Reservoir, Calif.	42.4	1952-64	1963	11.88	9,860	Dec. 23	10.96	7,400	
155	11-2943	North Fork Stanislaus River below Ganns damsite, near Big Meadow, Calif.	111	1955-64	1963	[9] 16.12	21,000	Dec. 24	15.22	17,300	[2] 1.15
156	11-2945	North Fork Stanislaus River near Avery, Calif.	163	1914-22, 1928-64.	1963	15.00	36,000	Dec. 24	14.00	29,000	[2] 1.34
157	11-2965	South Fork Stanislaus River at Strawberry, Calif.	44.8	1911-17, 1938-64.	1950	9.25	3,900	Dec. 24	6.52	1,810	
158	11-2980	South Fork Stanislaus River near Long Barn. Calif.	66.9	1937-64	1950	9.3	[6] 4,900	Dec. 24	7.20	[6] 2,350	
159	11-2990	Melones Reservoir at Melones Dam. Calif.	904	1927-64	1951	[4] 736.7	[11] 115,800	Dec. 24	[4] 736.6	[11] 155,600	
								Dec. 23		[14] 48,700	
								Dec. 24		[15] 38,700	
160	11-2995	Stanislaus River below Melones powerhouse, near Sonora, Calif.	905	1931-64	1955	29.0	[6] 62,800	Dec. 24	24.35	[6] 38,700	
161	11-2999.95	Tulloch Reservoir near Knights Ferry, Calif.	980	1957-64	1963	[4] 511.2	[11] 68,500	Jan. 7	[4] 512.0	[11] 69,500	
162	11-3020	Stanislaus River below Goodwin Dam, near Knights Ferry, Calif.	986	1903-64	1955	37.7	[6] 62,900	Dec. 24	[9] 28.85	[6] 40,200	
163	11-3030	Stanislaus River at Ripon, Calif		1940-64	1955	63.25	[6] 62,500	Dec. 25	62.26	[6] 32,800	
				1938	1938	64.4	([3])				
164	11-3035	San Joaquin River near Vernalis, Calif.	13,540	1922-64	1950	[4] 32.81	[6] 79,000	Jan. 12	[4] 28.27	[6] 22,800	
165	11-3040	Corral Hollow Creek near Tracy, Calif	61.6	1958-64	1962	2.54	145	Jan. 7	2.10	54	<2
166	11-3060	South Fork Calaveras River near San Andreas, Calif.	118	1950-64	1955	10.29	17,600	Jan. 6	7.99	7,940	27
167	11-3065	Calaveritas Creek near San Andreas, Calif.	53.0	1950-64	1958	6.65	4,410	Dec. 23	6.52	4,180	19
168	11-3080	North Fork Calaveras River near San Andreas, Calif.	85.2	1950-64	1955	12.52	6,200	Dec. 23	11.22	4,800	9
169	11-3083	Eldorado Creek at Mountain Ranch, Calif.	1.91	1962-64	1963	[7] 6.60	130	Dec. 22	5.79	122	
170	11-3087	New Hogan Reservoir near Valley Springs, Calif.	362	1963-64	1964	[4] 602.30	[11] 29,800	Jan. 20	[4] 669.67	[11] 166,000	
								Dec. 23		[13] 20,600	
171	11-3089	Calaveras River below New Hogan Dam, near Valley Springs, Calif.	363	1961-64	1963	6.76	[6] 7,020	Jan. 8-11, Jan. 21-25	3.34	[6] 1,640	
172	11-3090	Cosgrove Creek near Valley Springs, Calif.	21.1	1929-64	1955	8.96	3,240	Dec. 23	[9] 6.82	1,650	18
173	11-3095	Calaveras River at Jenny Lind, Calif.	393	1907-64	1911	21.0	50,000	Dec. 23	6.84	[6] 2,570	16
174	11-3114	Bear Creek tributary near Valley Springs, Calif.	.15	1959-64	1963	22.20	34	Dec. 22	21.14	10	
175	11-3120	Bear Creek near Lockeford, Calif.	47.6	1930-64	1958	15.13	2,930	Jan. 6	14.47	2,410	[16] 23
176	**11-3135**	Salt Springs Reservoir near West Point, Calif.	169	1931-64	([17])	[4] 3,958.0	[11] 141,900	Jan. 1, 2	[4] 3,888.5	[11] 81,800	

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Maximum flood previously known: Year	Maximum flood previously known: Gage height (ft)	Maximum flood previously known: Discharge (cfs)	Maximum December 1964 and January 1965: Day	Maximum December 1964 and January 1965: Gage height (ft)	Maximum December 1964 and January 1965: Discharge: Cfs	Maximum December 1964 and January 1965: Discharge: Recurrence interval (yr)
San Joaquin River and Sacramento River basins—Continued											
		San Joaquin River basin—Continued									
177	11-3145	North Fork Mokelumne River below Salt Springs Dam, Calif.	170	1926-64	1950	17.20	[6] 16,000	Dec. 24	10.49	[6] 4,790	.....
178	11-3150	Cole Creek near Salt Springs Dam, Calif.	20.4	1927-64	1963	9.88	5,730	Dec. 23	10.21	6,140	[2] 1.47
179	11-3160	Bear River near Salt Springs Dam, Calif.	48.0	1951-64	1957	5.35	[6] 3,060	Dec. 24	[9] 10.11	[6] 11,000	.....
				1950	1950	11.2	10,000	.....	.....	.....	.....
180	11-3166.5	Antelope Creek near West Point, Calif.	1.48	1962-64	1963	5.10	78	Dec. 22	4.66	60	.....
181	11-3168	Forest Creek near Wilseyville, Calif.	20.8	1960-64	1963	[9] 7.41	1,580	Dec. 24	7.68	1,770	15
182	11-3170	Middle Fork Mokelumne River at West Point, Calif.	68.4	1911-64	1955	8.98	4,320	Dec. 23	[9] 7.91	3,160	[16] 21
183	11-3185	South Fork Mokelumne River near West Point, Calif.	75.1	1933-64	1955	[1] 14.8	6,920	Dec. 23	10.19	4,870	[16] 18
184	11-3195	Mokelumne River near Mokelumne Hill, Calif.	544	1901, 1903-4, 1927-64.	1950	18.5	[6] 33,700	Dec. 24	17.31	[6] 29,700	.....
185	11-3200	Pardee Reservoir near Valley Springs, Calif.	578	1929-64	1955	[4] 571.72	[11] 219,300	Dec. 23	[4] 570.82	[11] 217,200	.....
186	11-3223	Camanche Reservoir near Clements, Calif.	621	1963-64	1964	[4] 162.20	[11] 62.000	Jan. 24	[4] 211.7	[11] 269,400	.....
187	11-3235	Mokelumne River below Camanche Dam, Calif.	627	1904-64	1950	[1] 24.40	[6] 28,800	Dec. 31	7.85	[6] 2.900	.....
188	11-3255	Mokelumne River at Woodbridge, Calif.	661	1924-64	1950	29.58	[6] 27,000	Jan. 3	17.23	[6] 2,910	.....
189	11-3263	Dry Creek above Sutter Creek, near Ione, Calif.	70.9	1960-64	1963	10.22	5,270	Jan. 6	11.30	7,300	40
190	11-3270	Sutter Creek near Sutter Creek, Calif.	48.1	1935-41, 1960-64.	1963	6.27	5,770	Dec. 23	4.77	2,400	6
191	11-3278	Clay Creek near Ione, Calif.	3.30	1959-64	1963	22.68	75	Jan. 5	29.87	432	.....
192	11-3295	Dry Creek near Galt, Calif.	329	1926-33, 1944-64.	1958	15.28	24,000	Dec. 23	14.36	14,500	14
193	11-3330	Camp Creek near Somerset, Calif.	62.6	1924, 1954-64.	1955	12.48	[6] 6,020	Dec. 23	12,50	[6] 6,040	.....
194	11-3335	North Fork Cosumnes River near El Dorado, Calif.	205	1911-41, 1948-64.	1955	14.8	[6] 15,800	Dec. 23	13.85	[6] 13,700	13
195	11-3342	Middle Fork Cosumnes River near Somerset, Calif.	107	1955-64	1963	[9] 16.20	11,800	Dec. 23	17.80	11,000	21

196	11-3343	South Fork Cosumnes River near River Pines, Calif.	64.3	1957–64	1963	10.90	5,540	Dec. 23	8.67	3,870	10
197	11-3350	Cosumnes River at Michigan Bar, Calif.	536	1908–64	1955	14.59	[6] 42,000	Dec. 23	13.80	[6] 37,500	25
				1907	1907	16.3	(3)				
198	11-3356.5	Deer Creek near Shingle Springs, Calif.	6.62	1962–64	1962	11.67	1,320	Dec. 22	8.30	710	
199	11-3357	Deer Creek near Sloughhouse, Calif.	46.0	1959–64	1962	12.86	6,560	Dec. 22	11.86	4,900	48
200	11-3360	Cosumnes River at McConnell, Calif.	724	1943–64	1955	46.26	54,000	Dec. 23	[9] 45.35	32,200	12
201	11-3365.8	Morrison Creek near Sacramento, Calif.	48.6	1959–64	1962	7.09	1,320	Dec. 23	6.00	1,040	(3)
		Goose Lake basin:									
202	11-3395	Drews Creek near Lakeview, Oreg.	212	1909–64	1910		3,000	Dec. 22	6.20	[6] 1,240	13
203	11-3405	Cottonwood Creek near Lakeview, Oreg.	32.9	1908–19, 1924–64.	1927		[18] 500–1,000	Dec. 26, 27	2.34	[6] 160	<2
204	11-3411	Salt Creek near Lakeview, Oreg.	5.62	1963–64	1964	15.84	69	Dec. 22	16.28	112	
		Sacramento River basin:									
205	11-3414	Sacramento River near Mount Shasta, Calif.	134	1959–64	1962	9.56	9,490	Dec. 22	10.60	12,200	(3)
206	11-3415.5	Boulder Creek near Lamoine, Calif.	6.57	1960–64	1962	39.78	2,080	Dec. 22	36.45	1,370	
207	11-3420	Sacramento River at Delta, Calif.	425	1944–64	1955	19.50	37,000	Dec. 22	[9] 20.10	38,800	33
208	11-3429.45	Thoms Creek near Cedarville, Calif.	1.06	1962–64	1963	8.04	119	Dec. 22	7.77	109	
209	11-3429.6	North Fork Pit River tributary near Alturas, Calif.	2.36	1962–64	1962	8.57	109	Jan. 11	7.42	69	
210	11-3435	North Fork Pit River near Alturas, Calif.	203	1929–32, 1957–64.	1962	11.07	[6] 2,530	Dec. 22	7.82	[6] 1,670	
211	11-3455	South Fork Pit River near Likely, Calif.	247	1928–64	1932	5.55	1,520	Dec. 24	4.10	[6] 435	<2
212	11-3458	South Fork Pit River tributary near Likely, Calif.	1.59	1964				Dec. 28	4.77	158	
213	11-3480.8	Big Sage Reservoir tributary near Alturas, Calif.	2.54	1962–64	1962	7.09	145	Jan. 5	5.30	98	
214	11-3485	Pit River near Canby, Calif.	[10] 1,431	1904–5, 1929–64.	1904	[1] 15.0	[6] 13,000	Dec. 24	8.32	[6] 4,020	7
215	11-3485.6	Turner Creek tributary near Canby, Calif.	.97	1962–64	1962	4.46	56	Dec. 22	3.18	13	
216	11-3490	Pit River near Lookout, Calif.	[10] 1,585	1929–31, 1958–64.	1962	19.39	[6] 8,170	Dec. 24	16.75	[6] 4,820	
217	11-3490.3	Pit River tributary near Lookout, Calif.	.47	1962–64	1962	4.84	45	Dec. 22	4.44	31	
218	11-3498.5	Johnson Creek tributary near Adin, Calif.	.66	1962–64	1963	4.99	73	Dec. 22	5.40	86	
219	11-3505	Ash Creek at Adin, Calif	258	1904–5, 1928–32, 1957–64.	1962	14.40	2,880	Dec. 22	13.70	2,410	22
220	11-3508.5	Willow Creek above Indian Springs, near Adin, Calif.	9.51	1962–64	1963	3.32	11	(3)	3.21	9.6	
221	11-3520	Pit River near Bieber, Calif.	[10] 2,475	1904–08, 1913–14, 1921–26, 1928–31, 1951–64.	1907	16.7	[6] 33,800	Dec. 23	9.80	[6] 8,880	30

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		San Joaquin River and Sacramento River basins—Continued									
		Sacramento River basin—Continued									
222	11-3525	Horse Creek at Little Valley, near Pittville, Calif.	237	1928-31, 1959-64.	1962	5.79	5,290	Jan. 24	4.06	760	(3)
223	11-3526.2	Pit River tributary near Pittville, Calif.	.31	1962-64	1962	8.03	68	Dec. 22	5.58	27	
224	11-3536	Dry Creek near Dana, Calif.	6.46	1962-64	1963	5.02	160	Dec. 22	10.69	702	
225	11-3537	Fall River near Dana, Calif.	[19] 123	1958-64	1958	10.25	2,190	Dec. 23	12.62	3,910	(3)
226	11-3551	Butte Creek tributary near Old Station, Calif.	5.15	1962-64	1963	2.40	7.4	Dec. 22	2.11	5.1	
227	11-3555	Hat Creek near Hat Creek, Calif.	162	1926-64	1937	7.75	3,320	Dec. 23	[9] 6.67	2,200	[16] 20
228	11-3598	Cayton Creek tributary near Dana, Calif.	.16	1962-64	1963	3.78	12	Dec. 22	4.40	20	
229	11-3625	Pit River below Pit No. 4 Dam, Calif.	[10] 4,647	1922-55	1937	17.90	[6] 30,200	Dec. 24	15.68	[6] 21,600	
				1955-64[6]	1962	14.59	[6] 17,800				
230	11-3630	Pit River at Big Bend, Calif.	[10] 4,710	1910-64	1937	16.26	[6] 34,200	Dec. 23	16.88	[6] 40,200	
231	11-3645.5	Willow Creek near Round Mountain, Calif.	2.61	1960-64	1963	18.72	784	Dec. 22	18.92	824	
232	11-3655	Squaw Creek above Shasta Lake, Calif.	64.0	1944-64	1955	21.90	17,800	Dec. 22	19.46	12,300	14
233	11-3675	McCloud River near McCloud, Calif.	358	1931-64	1955	9.42	11,800	Dec. 22	6.40	6,590	24
234	11-3678	McCloud River at Ah-di-na, near McCloud, Calif.	427	1955-64	1955	12.5	16,800	Dec. 22	9.43	9,660	(3)
235	11-3680	McCloud River above Shasta Lake, Calif.	604	1945-64	1955	28.20	45,200	Dec. 22	24.37	28,000	8
236	11-3700	Shasta Lake near Redding, Calif.	[10] 6,421	1942-64	1957	[4] 1,066.22	[11] 4,528,900	Dec. 27	[4] 1,021.44	[11] 3,321,700	
								Dec. 22		187,000	
237	11-3705	Sacramento River at Keswick, Calif.	[10] 6,468	1938-43	1940	[1] 47.2	186,000	Dec. 27	27.59	[13] 54,000	
				1944-64 [6]	1958	31.55	78,800				
238	11-3710	Clear Creek at French Gulch, Calif.	115	1950-64	1955	13.49	7,050	Dec. 22	13.70	7,600	[16] 50
239	11-3717	Whiskeytown Lake near Igo, Calif.	200	1963-64	1964	[4] 1,211.15	[11] 244,800	Dec. 23	[4] 1,211.27	[11] 245,200	
240	11-3720	Clear Creek near Igo, Calif.	228	1940-64	1955	13.75	24,500	Dec. 22	9.23	[6] 9,940	
241	11-3720.5	Churn Creek near Redding, Calif.	9.34	1959-64	1959	9.8	4,860	Dec. 22	8.74	3,160	
242	11-3722	South Cow Creek near Millville, Calif.	77.3	1956-64	1957	[1] 9.23	5,720	Jan. 5	8.57	5,510	6
243	11-3732	Oak Run Creek near Oak Run, Calif.	11.0	1957-64	1963	7.05	2,160	Jan. 5	6.02	976	(3)
244	11-3733	Little Cow Creek near Ingot, Calif.	60.6	1957-64	1963	17.00	9,090	Dec. 22	17.10	9,270	[2] 1.08
245	11-3740	Cow Creek near Millville, Calif.	425	1949-64	1951	21.55	45,200	Jan. 5	19.00	32,700	16
246	11-3740.6	Shingle Creek near Shingletown, Calif.	3.25	1960-64	1961	3.62	167	Jan. 5	3.86	197	
247	11-3741	Bear Creek near Millville, Calif.	75.6	1959-64	1961	10.44	3,140	Jan. 5	10.34	3,110	4
248	11-3744	Middle Fork Cottonwood Creek near Ono, Calif.	249	1956-64	1958	14.74	9,090	Dec. 22	19.08	13,500	

249	11-3756	Huling Creek tributary at Ono, Calif.	.067	1960-64	1962	4.14	11	Dec. 22	4.20	11	....
250	11-3757	North Fork Cottonwood Creek near Igo, Calif.	88.7	1955-64	1955	(3)	14,300	Dec. 22	[9] 39.45	11,000	(3)
251	11-3758.2	South Fork Cottonwood Creek near Cottonwood, Calif.	217	1962-64	1963	7.84	6,230	Dec. 22	13.6	13,400	....
252	11-3758.3	Budden Canyon near Beegum, Calif.	1.09	1960-64	1963	8.73	66	Dec. 22	10.25	120	....
253	11-3759.5	Cottonwood Creek tributary near Cottonwood, Calif.	.44	1960-64	1962	5.16	27	Jan. 5	6.09	59	....
254	11-3760	Cottonwood Creek near Cottonwood, Calif.	922	1940-64	1941	[1] 15.4	52,300	Dec. 22	19.64	60,000	[16] 27
255	11-3762	Summit Creek near Mineral, Calif	1.80	1960-64	1963	8.25	100	Dec. 22	10.42	204	....
256	11-3765.5	Battle Creek below Coleman Fish Hatchery, near Cottonwood, Calif.	358	1937-64	1937	[1] 15.8	35,000	Dec. 22	12.52	9,930	....
257	11-3775	Paynes Creek near Red Bluff, Calif	92.7	1949-64	1961	11.33	10,600	Jan. 5	9.97	7,500	10
258	11-3780	Sacramento River near Red Bluff, Calif.	[10] 9,022	1878-88, 1892-1964.	1940	38.9	[6] 291,000	Dec. 22	28.15	[6] 170,000	....
259	11-3787	Vale Gulch tributary near Red Bank, Calif.	.91	1960-64	1963	6.95	114	Jan. 5	6.54	84	....
260	11-3788	Red Bank Creek near Red Bluff, Calif.	93.5	1959-64	1963	8.67	5,770	Jan. 5	10.06	9,730	44
261	11-3790	Antelope Creek near Red Bluff, Calif.	123	1940-64	1956	12.43	11,500	Dec. 22	13.05	8,990	12
				1937	1937	[1] 22	(3)	....	....	....	....
262	11-3795	Elder Creek near Paskenta, Calif.	92.9	1948-64	1958	13.90	11,700	Dec. 22	13.23	10,300	12
263	11-3805	Elder Creek at Gerber, Calif.	136	1949-64	1958	[1] 14.40	11,000	Jan. 5	14.90	14,100	50
264	11-3815	Mill Creek near Los Molinos, Calif.	131	1928-64	1937	23.4	23,000	Dec. 22	15.26	16,000	[2] 1.17
265	11-3819.9	Thomes Creek tributary at Paskenta, Calif.	.64	1960-64	1963	5.83	57	Jan. 5	7.99	107	....
266	11-3820	Thomes Creek at Paskenta, Calif.	194	1920-64	1955	13.89	23,500	Dec. 22	[9] 15.32	37,800	[2] 1.37
267	11-3825.5	Deer Creek below Slate Creek, near Deer Creek Meadows, Calif.	69.4	1961-64	1963	[9] 9.06	4,970	Dec. 22	[9] 11.06	7,900	[2] 1.44
268	11-3835	Deer Creek near Vina, Calif.	208	1911-15, 1920-37, 1939-64.	1937	19.2	23,800	Dec. 22	14.67	18.800	38
269	11-3840	Big Chico Creek near Chico, Calif.	72.2	1930-64	1937	[1] 16.6	8,260	Jan. 5	15.36	9,580	[20] 1.08
270	11-3847	Gilmore Creek near Lodogo, Calif.	.49	1959-64	1963	23.12	53	Jan. 6	22.52	33	....
271	11-3864	Grindstone Creek tributary near Elk Creek, Calif.	.80	1959-64	1961	21.75	85	Jan. 6	18.44	47	....
272	11-3864.5	Watson Creek tributary near Newville, Calif.	.58	....	....	....	....	Jan. 5	13.90	116	....
273	11-3865	Grindstone Creek near Elk Creek, Calif.	172	1935-40, 1964.	1940	[1] 7.55	13,000	Dec. 23	9.38	22,200	(3)
274	11-3870	Stony Creek near Fruto, Calif.	598	1901-12, 1960-64.	1909	[1] 16.3	36,000	Dec. 23	[9] 15.49	40,200	8
275	11-3878	North Fork Stony Creek near Newville, Calif.	67.1	1963-64	1963	7.3	4,600	Jan. 5	[9] 11.48	12,500	(3)
276	11-3879.95	Black Butte Reservoir near Orland, Calif.	740	1963-64	1964	[4] 430.51	[11] 29,700	Dec. 23	[4] 457.45	[11] 97,100	....
								Dec. 23	....	[13] 44,300	....
277	11-3880	Stony Creek below Black Butte Dam, near Orland, Calif.	741	1955-64	1958	[1] 11.82	[6] 36,300	Dec. 25	10.41	[6] 19,400	....

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		San Joaquin River and Sacramento River basins—Continued									
		Sacramento River basin—Continued									
278	11-3885	Stony Creek near Hamilton City, Calif.	777	1940–64	1958	18.31	[6] 39,900	Dec. 24	14.48	[6] 18,700	
279	11-3890	Sacramento River at Butte City, Calif.	[10] 12,096	1940–64	1942	96.87	[6] 170,000	Dec. 24	94.89	[6] 126,000	
280	11-3895	Sacramento River at Colusa, Calif.	[10] 12,110	1940–64	1942	69.20	[6] 49,000	Jan. 7	67.07	[6] 43,900	
281	11-3897	Butte Creek at Butte Meadows, Calif.	44.4	1960–64	1963	7.03	3,220	Dec. 22	[9] 7.64	4,290	(3)
282	11-3900	Butte Creek near Chico, Calif.	147	1930–64	1955	13.35	18,700	Dec. 22	[9] 14.12	21,200	[2] 1.13
283	11-3900.45	Little Chico Creek tributary at Forest Ranch, Calif.	.65	1962–64	1962	4.82	34	Jan. 5	6.45	96	
284	11-3902	Gold Run tributary near Nelson, Calif.	1.31	1959–64	1963	5.79	205	Jan. 6	5.40	186	
285	11-3905	Sacramento River below Wilkins Slough, near Grimes, Calif.	[10] 12,940	1938–64	1958	51.41	[6] 28,900	Dec. 25	49.91	[6] 27,500	
286	11-3906.55	South Fork Willow Creek near Fruto, Calif.	38.9	1963–64	1964	2.74	2	Jan. 5	9.94	1,920	5
287	11-3906.72	Stone Corral Creek near Sites, Calif.	38.2	1958–64	1958	14.93	2,500	Dec. 23	13.0	1,940	(3)
288	11-3906.8	Salt Creek near Williams, Calif.	12.9	1959–64	1962	23.88	427	Jan. 5	26.43	809	3
289	11-3910	Sacramento River at Knights Landing, Calif.	[10] 14,550	1940–64	1942	[7] 41.83		Dec. 26	[7] [21] 41.10	[6] 27,300	
					1960		[6] 30,000				
290	11-3914	Little Last Chance Creek near Chilcoot, Calif.	84.2	1958–64	1960	5.56	784	Dec. 22	4.02	[6] 66	
291	11-3914.23	Cottonwood Creek near Sierraville, Calif.	7.08	1962–64	1963	5.17	162	Dec. 22	4.27	108	
292	11-3914.8	County Line Creek near Loyalton, Calif.	.33	1963–64	1964	2.99	2	Jan. 5	4.83	30	
293	11-3915	Big Grizzly Creek near Portola, Calif.	45.5	1925–32, 1950–53, 1954–64.	1963	8.03	4,080	Dec. 22	7.11	2,530	[2] 1.30
294	11-3923	Willow Creek tributary near Blairsden, Calif.	1.08	1962–64	1963	7.18	77	Dec. 22	5.13	22	
295	11-3925	Middle Fork Feather River near Clio, Calif.	686	1925–64	1963	16.19	14,500	Dec. 24	14,82	11,100	32
296	11-3945	Middle Fork Feather River near Merrimac, Calif.	1,062	1951–64	1963	[9] 21.65	65,400	Dec. 22	26.5	86,200	[2] 1.30
297	11-3946.2	Fall River near Feather Falls, Calif.	9.89	1963–64	1963	5.09	327	Dec. 22	10.00	3,770	
298	11-3948	South Fork Feather River above Little Grass Valley Reservoir, Calif.	8.09	1960–64	1963	[9] 7.12	4,160	Dec. 22	6.48	3,050	
299	11-3950.2	Little Grass Valley Reservoir near La Porte, Calif.	25.8	1961–64	1963	[4] 5,045.8	[11] 92,700	Dec. 24	[4] 5,039.04	[11] 82,100	
								Dec. 22		[13] 9,660	
300	11-3950.3	South Fork Feather River below Little Grass Valley Dam, Calif.	25.9	1927–33, 1960–64.	1963		[6] 4,250	Dec. 24		[6] 3,140	

301	11-3952	South Fork Feather River below diversion dam, near Strawberry Valley, Calif.	37.7	1960-64	1963	13.21	[6, 22] 6,330	Dec. 24	11.53	[6, 22] 4,970	
302	11-3953	Lost Creek above Sly Creek Reservoir, Calif.	14.1	1960-64	1963	7.87	4,570	Dec. 22	[9] 8.48	5,640	[2] 1.25
303	11-3954	Sly Creek Reservoir near Strawberry Valley, Calif.	24.0	1961-64	1962, 1963	[4] 3,531.5	[11] 65,500	Dec. 27	[4] 3,518.7	[11] 58,300	
304	11-3960	Lost Creek near Clipper Mills, Calif	30.0	1927-41, 1948-64.	1955	6.90	5,000	Dec. 26	4.95	[6] 1,940	
305	11-3962	South Fork Feather River below Forbestown Dam, Calif.	87.5	1962-64	1963	[9] 13.85	[6] 7,510	Dec. 22	[9] 12.50	[6] 5,320	
306	11-3963.5	South Fork Feather River below Ponderosa Dam, Calif.	108	1962-64	1963	11.24	[6, 22] 8,570	Dec. 22	[9] 11,52	[6, 22] 11,000	
307	11-3964	Sucker Run near Forbestown, Calif	18.7	1964				Dec. 22	7.4	1,260	
308	11-3970	South Fork Feather River at Enterprise, Calif.	132	1911-64	1955	21.60	19,200	Dec. 22	17.43	[6] 11,800	6
309	11-3979.7	Lake Almanor tributary near Almanor, Calif.	1.66	1962-64	1962	8.85	111	Dec. 23	7.41	81	
310	11-3990	Lake Almanor near Prattville, Calif	491	1913-64	1964	4,482.43	[11] 844,600	Jan. 31	4,477.43	[11] 727,500	
311	11-3995	North Fork Feather River near Prattville, Calif.	493	1905-64	1907	[1] 16.2	10,000	Dec. 22	2.73	[6] 50	
312	11-4005	Butt Creek below Almanor-Butt Creek tunnel, near Prattville, Calif.	68.8	1936-59, 1964.	1937	4.95	2,750	Dec. 23	5.87	3,830	
313	11-4011.5	Red Clover Creek near Genesee, Calif	122	1958-64	1963	9.49	7,870	Dec. 22	7.99	5,720	[2] 1.59
314	11-4011.8	Little Grizzly Creek near Genesee, Calif	29.6	1964	1964	1.75	23	Dec. 23	[9] 5.90	1,600	20
315	11-4012	Indian Creek near Taylorsville, Calif	526	1957-64	1963	[1] 10.65	30,200	Dec. 22	15.24	14,100	32
				1955	1955	11.5	(3)				
316	11-4014.6	Hough Creek near Crescent Mills, Calif	3.79	1963-64	1963	3.93	159	Dec. 23	4.42	205	
317	11-4015	Indian Creek near Crescent Mills, Calif	739	1906-9, 1911-18, 1930-64.	1907	[1] 20.2	25,000	Dec. 23	16.70	21,400	22
318	11-4019.4	Mill Creek near Quincy, Calif	6.72	1962-64	1963	5.53	447	Dec. 22	7.02	601	
319	11-4020	Spanish Creek above Blackhawk Creek, at Keddie, Calif.	184	1933-64	1963	[9] 13.37	15,000	Dec. 22	13.53	15,400	[16] 31
320	11-4027	Kingsbury Creek near Twain, Calif	1.36	1962-64	1962	4.75	114	Dec. 22	5.94	163	
321	11-4033.4	Granite Creek at Tobin, Calif	.79	1962-64	1962	9.01	72	Dec. 22	11.57	158	
322	11-4035	Bucks Lake near Bucks Lodge, Calif	28.6	1928-64	1938	[4] 5,157.1	[11] 105,800	Jan, 12-16	[4] 5,143.8	[11] 82,200	
323	11-4045	North Fork Feather River at Pulga, Calif.	1,953	1910-58,	1955	35.60	72,400	Dec. 22	35.80	[6] 73,000	
				1958-64.[6]	1963	31.72	54,900				
324	11-4053	West Branch Feather River near Paradise, Calif.	113	1957-64	1963	23.35	21,200	Dec. 22	26.2	26,300	26
325	11-4069	Oroville Reservoir near Oroville, Calif	3,609	1964				Dec. 23	450.0	[11] 155,200	
								Dec. 22		[23] 252,000	
326	11-4070	Feather River at Oroville, Calif	3,624	1901-64	1907	[4] 167.5	230,000	Dec. 23	25.24	[6] 158,000	
327	11-4071.5	Feather River near Gridley, Calif	3,676	1944-64	1955	102.25	(3)	Dec. 23	100.43	[6] 151,000	
328	11-4073	North Honcut Creek near Bangor, Calif	47.1	1960-62, 1963-64.	1964	9.46	5,010	Dec. 26	11.57	10,700	(3)

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		San Joaquin River and Sacramento River basins—Continued									
		Sacramento River basin—Continued									
329	11-4074	Wyman Ravine tributary near Palermo, Calif.	1.72	1959-64	1962	13.70	260	Jan. 5	11.14	50	
330	11-4075	South Honcut Creek near Bangor, Caif.	30.6	1950-64	1962	12.40	8,280	Dec. 26	[9] 19.25	17,600	[2] 2.94
331	11-4078	Jackson Meadows Reservoir near Sierra City, Calif.	37.4	1964				Jan. 1	[4] 6,000.3	[11] 35,600	
332	11-4079	Middle Yuba River below Jackson Meadows Dam, near Sierra City, Calif.	38.2	1925-64	1963	10.57	10,000	Dec. 24	3.72	[6] 277	
333	11-4085	Middle Yuba River at Milton, Calif.	39.8	1925-64	1963	5.25	10,200	Dec. 22	.78	[6] 450	
334	11-4087	Middle Yuba River near Alleghany, Calif.	96.6	1957-64	1963	[9] 18.95	23,700	Dec. 22	[9] 14.70	[5] 13,900	
335	11-4090	Middle Yuba River above Oregon Creek, near North San Juan, Calif.	162	1910-64	1963	18.55	31,600	Dec. 22	[9] 16.26	[6] 22,900	
336	11-4095	Oregon Creek near North San Juan, Calif.	34.4	1911-64	1955	11.90	5,390	Dec. 22	12,88	10,300	[2] 1.25
337	11-4104	Haypress Creek near Sierra City, Calif.	18.2	1960-64	1963	[9] 3.75	3,100	Dec. 23	3.75	3,100	[2] 1.48
338	11-4127	North Yuba River tributary at Goodyears Bar, Calif.	.24	1962-64	1963	9.07	75	Dec. 22	8.04	67	
339	11-4130	North Yuba River below Goodyears Bar, Calif.	250	1930-64	1963	23.8	40,000	Dec. 22	23.0	37,600	40
340	11-4133	Slate Creek below diversion dam, near Strawberry Valley, Calif.	49.4	1960-64	1963	15.90	[6, 22] 12,200	Dec. 22	16.42	[6, 22] 13,100	[2] 1.09
341	11-4135	North Yuba River below Bullards Bar Dam, Calif.	487	1940-64	1963	42.0	83,000	Dec. 22	[9] 40.45	91,600	(3)
342	11-4136	Sweetland Creek near North San Juan, Calif.	2.68	1962-64	1962	6.17	526	Dec. 22	7.04	600	
343	11-4139.5	South Yuba River tributary near Soda Springs, Calif.	.90	1962-64	1963	21.84	489	Dec. 23	21.91	585	
344	11-4140	South Yuba River near Cisco, Calif.	51.8	1942-64	1963	[9] 19.6	18,400	Dec. 23	17.49	14,400	[2] 1.43
345	11-4141.4	Lake Spaulding near Emigrant Gap, Calif.	118	1913-64	1955	203.45	[11] 73,700	Dec. 22	203.7	[11] 73,900	
346	11-4155	Bowman Lake near Graniteville, Calif.	27.1	1926-64	1964	[4] 5,566.1	[11] 70,700	Dec. 26, 27	[4] 5,564.0	[11] 60,000	
347	11-4165	Canyon Creek below Bowman Lake, Calif.	28.3	1927-64	1950	6.28	[6] 2,520	Dec. 25	6.25	[6] 2,600	
348	11-4170	South Yuba River near Washington, Calif.	198	1942-64	1963	[9] 17.16	[6] 28,500	Dec. 23	20.0	[6] 35,300	
349	11-4171	Poorman Creek near Washington, Calif.	23.1	1961-64	1963	[9] 10.95	4,320	Dec. 22	[9] 12.52	6,090	[2] 1.19

350	11-4175	South Yuba River at Jones Bar, near Grass Valley, Calif.	308	1940-48, 1959-64.	1963	21.5	[6] 40,000	Dec. 22	25.0	[6] 53,600	
				1955	1955	28.7	(3)				
351	11-4180	Yuba River at Englebright Dam, Calif.	1,108	1941-64	1963		150,000	Dec. 22	[4] 546.14	171,000	(3)
352	11-4185	Deer Creek near Smartville, Calif.	84.6	1935-64	1962	13.77	[6] 11,600	Dec. 22	11.85	[6] 8,260	5
353	11-4203	Willow Glen Creek near Rackerby, Calif.	1.95	1962-64	1962	10.75	344	Dec. 27	9.92	222	
354	11-4207	Dry Creek near Browns Valley, Calif.	87.1	1964	1964	2.89	[6] 41	Jan. 5	9.65	[6] 4,810	
355	11-4210	Yuba River near Marysville, Calif.	1,339	1943-64	1955	88.85	[6] 160,000	Dec. 22	90.15	[6] 180,000	
356	11-4218	Rollins Reservoir near Colfax, Calif.	104	1964				Jan. 6	[4] 2,173.2	[11] 67,800	
								Dec. 22		[13] 19,100	
357	11-4225	Bear River below Rollins Dam, near Colfax, Calif.	105	1912-13, 1915-17, 1949-53, 1964.	1950	[1] 21.40	9,620	Jn. 6	8.45	[6] 6,620	
358	11-4230	Bear River near Auburn, Calif.	138	1940-64	1955	[1] 16.56	19,700	Jan. 6	14.03	[6] 7,900	
359	11-4230.5	Magnolia Creek near Auburn, Calif.	5.65	1962-64	1962	12.01	1,380	Dec. 22	11.67	1,300	
360	11-4240	Bear River near Wheatland, Calif.	292	1928-64	1955		33,000	Jan. 6	10.53	[6] 12,700	
					1950	[1] 20.83					
361	11-4246	Wellman Creek near Smartville, Calif.	.59	1959-64	1964	15.66	467	Dec. 22	13.75	67	
362	11-4250	Feather River at Nicolaus, Calif.	5,921	1943-64	1955	51.60	357,000	Dec. 23	51.55	[6] 281,000	
363	11-4255	Sacramento River at Verona, Calif.	21,275	1926-64	1940	41.20	[6] 79,200	Dec. 25	39.65	[6] 74,200	
364	11-4260	Sarcamento Weir spill to Yolo bypass, near Sacramento, Calif.		1926-64	1928		118,000	Dec. 25	32.27	86,600	
					1955	33.01					
365	11-4261.5	Onion Creek near Soda Springs, Calif.	3.58	1959-64	1963	3.64	960	Dec. 23	[9] 4.98	1,750	
366	11-4262	North Fork Forbes Creek near Dutch Flat, Calif.	1.68	1956-64	1963	4.18	[6] 200	Jan. 8	3.99	[6] 162	
				1955	1955	6.40	(3)				
367	11-4264	North Shirttail Creek near Dutch Flat, Calif.	9.10	1955-64	1955	7.30	1,650	Dec. 22	7.56	1,780	
368	11-4270	North Fork American River at North Fork Dam, Calif.	343	1941-64	1963	11.30	59,700	Dec. 23	11.87	65,400	[2] 1.21
369	11-4274	French Meadows Reservoir near Foresthill, Calif.	47.0	1964				Jan. 31	[4] 5,215.3	[11] 75,200	
370	11-4275	Middle Fork American River at French Meadows, Calif.	47.9	1951-64	1963	[9] 14.20	21,500	Dec. 21	6.70	[6] 575	
371	11-4277	Duncan Creek near French Meadows, Calif.	9.94	1960-64	1963	[9] 8.78	2,720	Dec. 22	10.6	3,650	
372	11-4277.5	Duncan Creek below diversion dam near French Meadows, Calif.	10.5	1964				Dec. 22	[9] 8.74	[6] 3,640	
373	11-4280	Rubicon River at Rubicon Springs, near Meeks Bay, Calif.	31.4	1910-14, 1955-64.	1963	14.28	[22] 11,500	Dec. 23	13.51	[6] [22] 10,100	[2] 1.68
374	11-4293.5	Loon Lake near Meeks Bay, Calif.	7.94	1963-64	1964	[4] 6,380.7	[11] 39,400	Jan. 31	[4] 6,380.8	[11] 39,500	
								Dec. 23		[13] 3,000	
375	11-4295	Gerle Creek below Loon Lake Dam, near Meeks Bay, Calif.	8.01	1910-14, 1962-64.	1963	12.65	[6] 3,240	Dec. 1	5.49	[6] 312	
376	11-4300	South Fork Rubicon River below Gerle Creek near Georgetown, Calif.	47.6	1910-14, 1961-64.	1963	[9] 12.32	11,500	Dec. 23	[9] 11.37	[6] 8,620	
377	11-4310	Rubicon River near Georgetown, Calif.	195	1909-14, 1943-64.	1963	25.8	58,000	Dec. 23	71	(3)	

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Maximum flood previously known: Year	Maximum flood previously known: Gage height (ft)	Maximum flood previously known: Discharge (cfs)	Maximum December 1964 and January 1965: Day	Maximum December 1964 and January 1965: Gage height (ft)	Discharge: Cfs	Discharge: Recurrence interval (yr)
		San Joaquin River and Sacramento River basins—Continued									
		Sacramento River basin—Continued									
378	11-4318	Pilot Creek above Stumpy Meadows Reservoir, Calif.	11.7	1960–64	1963	8.05	2,070	Dec. 23	[9] 5.92	2,380	29
379	11-4330.4	Pilot Creek below Mutton Canyon, near Georgetown, Calif.	21.1	1961–64	1963	5.00	[6] 690	Dec. 22	[21] 10.06	[6] 5,430	(3)
380	11-4331	Long Canyon Creek near French Meadows, Calif.	18.0	1960–64	1963	[9] 10.27	3,540	Dec. 23	11.20	4,690	[2] 1.12
381	11-4332	Rubicon River near Foresthill, Calif.	311	1958–64	1963	35.0	83,000	Dec. 23	55.4	(3)	
382	11-4333	Middle Fork American River near Foresthill, Calif.	534	1958–64	1963	38.00	113,000	Dec. 23	69.0	[6] [24] 310,000	
383	11-4335	Middle Fork American River near Auburn, Calif.	612	1911–64	1963	43.1	121,000	Dec. 23	60.4	[6] [24] 253,000	
384	11-4360	Silver Lake outlet near Kirkwood, Calif.	15.2	1922–64	1950	6.03	[6] 676	Dec. 24	5.39	[6] 560	
385	11-4375.6	Kirkwood Creek near Silver Lake, Calif.	3.62	1962–64,	1963	9.71	385	Dec. 23	9.6	263	
386	11-4395	South Fork American River near Kyburz, Calif.	193	1907, 1923–64.	1963	10.53	[6] [22] 15,500	Dec. 23	10.92	[6] [22] 17,400	
387	11-4400	Alder Creek near White Hall, Calif.	22.1	1922–64	1955	8.40	5,500	Dec. 23	6.94	2,980	32
388	11-4408.5	Picket Pen Creek near Kyburz, Calif.	.49	1963–64	1963	10.52	53	Dec. 23	13.47	111	
389	11-4410.01	Union Valley Reservoir near Riverton, Calif.	83.6	1962–64	1963 1963	[4] 4,869.8	[11] 270,400 [13] 21,100	Dec. 27 Dec. 23	[4] 4,854.3	[11] 229,200 [13] 19,800	
390	11-4411	Ice House Reservoir near Kyburz, Calif.	27.2	1959–64	1961	[6] 5,450.24	[11] 46,100	Jan. 14	[4] 5,437.0	[11] 37,300	
391	11-4415	South Fork Silver Creek near Ice House, Calif.	27.5	1924–64	1955	[1] 6.71	3,940	Jan. 21–22	3.68	[6] 153	
392	11-4419	Silver Creek below Camino diversion dam, Calif.	171	1960–64	1963	[9] 11.28	[6] 19,300	Dec. 22	[9] 10.38	[6] 13,600	
393	11-4435	South Fork American River near Camino, Calif.	501	1922–64	1955	[1] 32.6	[6] [22] 49,800	Dec. 23	21.01	[6] [22] 36,000	11
394	11-4445	South Fork American River near Placerville, Calif.	598	1911–20, 1964.	1914 1964	[1] 19.00 4.27	15,000 [6] 1,220	Dec. 23	17.4	[6] 47,300	(3)
395	11-4455	South Fork American River near Lotus, Calif.	673	1862–1964	1955	21.37	[6] 71,800	Dec. 23	20.00	[6] 61,500	24
396	11-4462	Folsom Lake near Folsom, Calif.	1,862	1955–64	1963	[4] 467.23	[5] 1,024,400	Dec. 23 Dec. 23	[4] 456.02	[5] 898,900 [13] 238,300	

397	11-4465	American River at Fair Oaks, Calif.	1,888	1904-52	1950	[1] 31.85	180,000	Dec.	21.65	[6] 115,000	...
				1952-64.	1963	21.44	101,000	23-25	...	...	...
398	11-4473	Dry Creek tributary near Roseville, Calif.	.39	1959-64	1962	17.00	220	Dec. 22	14.38	48	...
399	11-4473.6	Arcade Creek near Del Paso Heights, Calif.	31.5	1963-64	1964	12.26	1,470	Dec. 22	12.72	1,360	(3)
400	11-4475	Sacramento River at Sacramento, Calif.	23,530	1909-64	1950	[1] 30.14	[6] 104,000	Dec. 25	29.36	[6] 99,700	...
401	11-4485	Adobe Creek near Kelseyville, Calif.	6.36	1954-64	1963	9.22	1,450	Dec. 22	9.11	1,500	...
402	11-4489	Highland Creek above Highland Creek Dam, Calif.	11.9	1962-64	1962	10.98	2,320	Dec. 22	12.15	3,080	[2] 1.03
403	11-4440.6	Lyons Creek tributary near Lakeport, Calif.	.16	1962-64	1963	12.08	30	Jan. 7	13.17	44	...
404	11-4491	Scotts Creek near Lakeport, Calif.	52.3	1960-64	1963	14.02	6,500	Dec. 22	17.88	8,680	26
405	11-4493.5	Burns Valley Creek near Clearlake Highlands, Calif.	4.38	1963-64	1963	4.38	277	Jan. 5	5.11	402	...
406	11-4494.5	Copsey Creek near Lower Lake, Calif.	13.2	1960-64	1963	14.15	2,340	Jan. 5	12.38	2,210	(3)
407	11-4495	Kelsey Creek near Kelseyville, Calif.	37.2	1946-64	1955	12.80	8,800	Jan. 5	13.48	8,750	32
408	11-4500	Clear Lake at Lakeport, Calif.	528	1913-64	1914	11.12	...	Jan. 8	[25] 9.10	...	...
409	11-4510	Cache Creek near Lower Lake, Calif.	528	1944-64	1958	9.40	[6] 8,000	Jan. 5	8.21	[6] 5,320	...
410	11-4515	North Fork Cache Creek near Lower Lake, Calif.	197	1930-64	1937	13.98	20,300	Dec. 22	12.7	19,700	[16] 17
411	11-4515.3	Phipps Creek near Lower Lake, Calif.	3.05	1962-64	1963	12.95	99	Jan. 5	14.47	180	...
412	11-4517	Bear Creek tributary near Wilbur Springs, Calif.	4.50	1959-64	1963	27.54	357	Jan. 5	29.0	531	...
413	11-4517.2	Bear Creek near Rumsey Calif.	100	1955-64	1958	12.33	(3)	Jan. 5	11.93	9,720	10
					1963	9.95	5,600	...	...	...	...
414	11-4517.6	Cache Creek above Rumsey, Calif.	955	1960-62	1960	12.90	[6] 13,200	Jan. 5	21.42	[6] 59,000	...
415	11-4520	Cache Creek near Capay, Calif.	1,044	1942-64	1958	20.90	[6] 51,600	Jan. 5	19.76	[6] 44,500	...
416	11-4525	Cache Creek at Yolo, Calif.	1,138	1903-64	1958	...	[6] 41,400	Jan. 6	31.56	[6] 37,800	...
					1904	34.2	...	...	...	...	...
417	11-4530	Yolo bypass near Woodland, Calif.	...	1939-64	1942	32.00	272,000	Dec. 25	32.48	265,000	...
418	11-4531.5	Putah Creek tributary near Whispering Pines, Calif.	.24	1958-64	1963	13.60	58	Dec. 22	13.00	50	...
419	11-4532	Dry Creek near Middletown, Calif.	8.41	1959-64	1960	9.90	3,470	Dec. 22	9.70	3,210	...
420	11-4535	Putah Creek near Guenoc, Calif.	112	1904-6, 1930-64.	1937	22.7	32,000	Dec. 22	19.15	21,700	22
421	11-4536	Pope Creek near Pope Valley, Calif.	78.3	1960-64	1963	19.79	18,000	Dec. 22	18.34	13,600	(3)
422	11-4537	Capell Creek tributary near Wooden Valley, Calif.	.87	1958-64	1963	[9] 7.29	376	Jan. 5	[9] 5.24	162	...
423	11-4538	Wragg Creek near Winters, Calif.	.66	1964	...	...	...	Jan. 5	6.78	169	...
424	11-4539	Lake Berryessa near Winters, Calif.	566	1957-64	1963	[4] 440.89	[11] 1,619,500	Jan. 6	[4] 444.30	[11] 1,686,100	...
								Dec. 22	...	[13] 67,100	...
425	11-4540	Putah Creek near Winters, Calif.	574	1905-64	1940	30.5	81,000	Jan. 7	14.96	[6] 7,740	...
426	11-4541	Pleasants Creek near Winters, Calif.	15.9	1959-64	1963	12.36	3,780	Jan. 5	10.05	2,200	13

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station no.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Maximum flood previously known: Year	Maximum flood previously known: Gage height (ft)	Maximum flood previously known: Discharge (cfs)	Maximum December 1964 and January 1965: Day	Maximum December 1964 and January 1965: Gage height (ft)	Maximum December 1964 and January 1965: Discharge: Cfs	Maximum December 1964 and January 1965: Discharge: Recurrence interval (yr)
		North-coastal California									
		Napa River basin:									
427	11-4559.5	Sulphur Creek near St. Helena, Calif	4.50	1957-64	1957	13.53	924	Dec. 23	10.80	980	
				1955	1955	15.8	(3)				
428	11-4560	Napa River near St. Helena, Calif	81.4	1929-32, 1939-64.	1955	16.17	12,600	Jan. 5	14.96	11,800	[16] 14
429	11-4564	Lake Hennessey tributary near Rutherford, Calif.	1.04	1958-64	1963	7.71	142	Jan. 5	8.50	184	
430	11-4570	Dry Creek near Napa, Calif	17.4	1951-64	1958	8.11	3,460	Jan. 5	7.62	2,970	17
431	11-4580	Napa River near Napa, Calif	218	1929-32, 1959-64.	1963	27.59	16,900	Jan. 5	25.10	14,300	(3)
432	11-4582	Redwood Creek near Napa, Calif	9.81	1958-64	1963	9.90	1,330	Jan. 5	10.44	1,450	6
		Sonoma Creek basin:									
433	11-4584	Sonoma Creek near Kenwood, Calif	6.06	1957-64	1958	13.25	1,510	Jan. 5	16.35	(3)	
					1960	[7] 17.10					
434	11-4585	Sonoma Creek at Boyes Hot Springs, Calif.	62.2	1955-64	1955	17.10	8,880	Jan. 5	15.56	7,520	12
		Novato Creek basin:									
435	11-4595	Novato Creek near Novato, Calif	17.5	1946-64	1964	8.74	1,330	Jan. 5	7.53	1,120	3
		Corte Madera Creek basin:									
436	11-4600	Corte Madera Creek at Ross, Calif	18.1	1951-64	1955	17.45	3,620	Jan. 5	11.57	1,400	2
		Redwood Creek basin:									
437	11-4601.5	Redwood Creek near Tamalpais Valley, Calif.	6.38	1961-64	1962	6.67	880	Jan. 6	5.48	410	
		Lagunitas Creek basin:									
438	11-4604.4	Nicasio Creek near Nicasio, Calif	1.74	1961-64	1964	15.26	541	Jan. 5	14.53	485	
		Walker Creek basin:									
439	11-4608	Walker Creek near Tomales, Calif	37.1	1959-64	1961		3,430	Jan. 5	19.86	4,340	13
					1962		3,430				
					1964	18.52	3,430				
				1958	1958	19.8	4,300				
		Johnson Gulch basin:									
440	11-4609	Roscoe Creek at Bodega Bay, Calif	.25	1961-64	1963	8.59	48	Jan. 5	8.18	38	

		Salmon Creek basin:									
441	11-4609.2	Salmon Creek at Bodega, Calif	15.7	1962-64	1963	15.56	1,430	Jan. 5	16.25	1,540	2
		Russian River basin:									
442	11-4609.4	Russian River near Redwood Valley, Calif.	14.1	1963-64	1964	7.22	1,500	Dec. 22	11.71	4,400	[2] 1.18
443	11-4610	Russian River near Ukiah, Calif	99.7	1911-13, 1952-64.	1955	21.0	18,900	Dec. 22	19.44	17,900	24
444	11-4614	East Fork Russian River tributary near Potter Valley, Calif.	.15	1958-64	1962	11.72	94	Dec. 22	14.46	121	....
445	11-4615	East Fork Russian River near Calpella, Calif.	93.0	1941-64	1955	[1] 15.06	[6] 13,300	Dec. 22	20.21	[6] 18,700	[20] 1.07
446	11-4620	East Fork Russian River near Ukiah, Calif.	105	1911-13, 1951-56, 1957-64.	1955	[1] 16.86	[6] 13,300	Dec. 30	10.82	[6] 6,780	....
447	11-4621.25	Slide Creek near Ukiah, Calif	.57	1958-64	1959	13.64	65	Dec. 23	16.00	163	....
448	11-4625	Russian River near Hopland, Calif	362	1939-64	1955	27.00	45,000	Dec. 22	26.01	41,500	24
				1937	1937	30.0	(3)	....	....	....	....
449	11-4627	Feliz Creek near Hopland, Calif.	31.1	1958-64	1963	13.43	2,910	Dec. 22	14.10	6,080	19
					1964	13.60	....	....	....	....	....
				1955	1955	13.60	2,710	....	....	....	....
450	11-4630	Russian River near Cloverdale, Calif	502	1951-64	1955	30.9	53,000	Dec. 22	31.60	55,200	24
451	11-4632	Big Sulphur Creek near Cloverdale, Calif.	82.3	1957-64	1958	14.46	14,200	Dec. 22	15.08	15,700	13
				1955	1955	16.8	20,000	....	....	....	....
452	11-4639	Maacama Creek near Kellogg, Calif	43.4	1958-64	1958	[1] 20.6	8,100	Dec. 22	17.56	8,920	16
453	11-4639.4	Franz Creek near Kellogg, Calif	15.7	1955-64	1955	7.8	4,130	Jan. 5	8.31	5,780	[2] 1.65
454	11-4640	Russian River near Healdsburg, Calif	793	1939-64	1940	30.0	67,000	Dec. 23	27.00	71,300	11
				1937	1937	30.8	....	....	....	....	....
455	11-4640.5	Dry Creek tributary near Hopland, Calif.	1.27	1958-64	1963	3.99	193	Dec. 22	7.41	430	....
456	11-4645	Dry Creek near Cloverdale, Calif	87.8	1941-64	1963	17.91	17,700	Dec. 22	18.09	18,100	44
				1937	1937	18	....	....	....	....	....
457	11-4650.5	Dutcher Creek near Asti, Calif	2.24	1958-64	1959	9.46	381	Dec. 22	9.04	335	....
458	11-4652	Dry Creek near Geyserville, Calif	162	1959-64	1963	17.50	32,400	Dec. 22	17.4	31,800	50
459	11-4658	Santa Rosa Creek near Santa Rosa, Calif.	12.5	1959-64	1960	13.35	3,200	Jan. 5	12.28	2,480	20
460	11-4670	Russian River near Guerneville, Calif	1,340	1939-64	1955	49.7	90,100	Dec. 23	49.6	93,400	[16] 25
461	11-4670.4	Ward Creek tributary near Cazadero, Calif.	.11	1961-64	1962	10.78	35	Dec. 22	10.92	37	....
462	11-4672	Austin Creek near Cazadero, Calif	63.1	1959-64	1962	20.6	15,100	Dec. 21	16.80	12,100	5
		Gualala River basin:									
463	11-4673	Wheatfield Fork Gualala River tributary near Annapolis, Calif.	0.19	1961-64	1962	9.90	54	Jan. 5	9.26	35	....
464	11-4675	South Fork Gualala River near Annapolis, Calif.	161	1950-64	1955	[1] 24.57	55,000	Dec. 21	15.94	21,400	5
465	11-4675.6	China Gulch at Gualala, Calif	.54	1961-64	1962	13.96	112	Jan. 5	12.67	68	....

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Maximum flood previously known: Year	Maximum flood previously known: Gage height (ft)	Maximum flood previously known: Discharge (cfs)	Maximum December 1964 and January 1965: Day	Maximum December 1964 and January 1965: Gage height (ft)	Discharge: Cfs	Discharge: Recurrence interval (yr)
		North-coastal California—Continued									
		Garcia River basin:									
466	11-4676	Garcia River near Point Arena, Calif	98.5	1951-56, 1962-64.	1955	[1] 20.75	26,300	Dec. 21	15.72	26,100	[2] 1.09
		Navarro River basin:									
467	11-4678	Rancheria Creek near Boonville, Calif	65.6	1959-64	1963	18.30	13,900	Dec. 22	20.52	20.000	[2] 1.11
468	11-4678.5	Soda Creek tributary near Boonville, Calif.	1.53	1961-64	1963	(3)	(3)	Dec. 22	21.03	394	
469	11-4678.8	Navarro River tributary near Philo, Calif.	.65	1961-64	1962	8.41	68	Jan. 5	6.78	26	
470	11-4680	Navarro River near Navarro, Calif	303	1950-64	1955	40.60	64,500	Dec. 22	38.64	52,100	38
		Albion River basin:									
471	11-4680.1	Albion River near Comptche, Calif	14.4	1961-64	1962	8.30	1,310	Dec. 21	9.50	2,050	4
472	11-4680.2	Albion River tributary near Comptche, Calif.	.40	1961-64	1962	8.97	50	Dec. 22	9.57	68	
		Big River basin:									
473	11-4680.7	South Fork Big River near Comptche, Calif.	36.2	1960-64	1963	10.77	2,930	Dec. 22	16.30	8,200	18
474	11-4680.85	North Fork Big River tributary near Willits, Calif.	.43	1961-64	1964	(3)	(3)	Dec. 22	(3)	165	
		Warner Creek basin:									
475	11-4681.5	Warner Creek near Fort Bragg, Calif	.61	1961-64	1964	9.13	64	Dec. 22	10.20	99	
		Noyo River basin:									
476	11-4685	Noyo River near Fort Bragg, Calif	106	1951-64	1955	25.64	22,000	Dec. 22	26.30	24,000	27
		Pudding Creek basin:									
477	11-4685.4	Pudding Creek near Fort Bragg, Calif	12.5	1963-64	1964	5.90	830	Dec. 21	8.55	2,000	3
		Tenmile River basin:									
478	11-4686	Middle Fork Tenmile River near Fort Bragg, Calif.	32.9	1964	1964	7.91	1,110	Dec. 21	15.34	5,670	3
		Cottoneva Creek basin:									
479	11-4688.5	Dunn Creek near Rockport, Calif	1.88	1961-64	1964	6.60	95	Dec. 22	9.59	286	

		Mattole River basin:									
480	11-4688.8	Painter Creek near Redway, Calif.	.64	1961-64	1964	53.52	166	Dec. 22	56.20	356	
481	11-4690	Mattole River near Petrolia, Calif.	240	1911-13, 1950-64.	1955	29.60	90,400	Dec. 22	27.86	78,500	34
		Oil Creek basin:									
482	11-4695.7	Oil Creek near Ferndale, Calif.	.13	1961-64	1963, 1964	52.11	10	Dec. 22	53.55	25	
		Eel River basin:									
483	11-4700	Lake Pillsbury near Potter Valley, Calif.	289	1922-64	1925	1,910.8	[11] 95,600	Dec. 22	1,911.84	[11] 91,000	
484	11-4705	Eel River below Scott Dam, near Potter Valley, Calif.	290	1922-64	1937	22.9	[6] 41,100	Dec. 22	24.24	[6] 56,300	
485	11-4707	Alder Creek near Potter Valley, Calif.	1.39	1962-64	1963	54.52	149	Dec. 22	(3)	2,340	
486	11-4715	Eel River at Van Arsdale Dam, near Potter Valley, Calif.	349	1909-64	1955	31.4	[6] 48,600	Dec. 22	33.9	[6] 64,100	
487	11-4718	Tomki Creek near Willits, Calif.	43.4	1963-64	1964	9.64	4,630	Dec. 22	15.92	16,500	[2] 1.27
488	11-4721.7	Fulweiter Creek tributary near Willits, Calif.	.71	1962-64	1962	54.85	99	Dec. 22	(3)	184	
489	11-4722	Outlet Creek near Longvale, Calif.	161	1956-64	1960	20.27	33,300	Dec. 22	30.6	77,900	[2] 1.69
490	11-4725	Eel River above Dos Rios, Calif.	705	1950-64	1955	45.4	[6] 123,000	Dec. 22	55.4	[6] 184,000	(3)
491	11-4729	Black Butte River near Covelo, Calif.	162	1953-57, 1958-64.	1955	[1] 35.8	25,000	Dec. 22	26.4	29,000	26
				1937	1937	[1] 36.2	26,000				
492	11-4730	Middle Fork Eel River below Black Butte River, near Covelo, Calif.	367	1951-64	1955	25.0	89,100	Dec. 22	31.7	133,000	[2] 1.55
493	11-4731	Williams Creek near Covelo, Calif.	30.4	1961-64	1963	8.87	5,900	Dec. 22	14.25	11,300	[2] 1.16
494	11-4735.3	Mill Creek below Alder Creek, near Covelo, Calif.	17.1	1961-64	1963	17.73	2,200	Dec. 22	22.4	5,410	36
495	11-4735.7	Mill Creek tributary near Covelo, Calif.	.26	1962-64	1963	11.80	25	Dec. 22	14.80	85	
496	11-4736	Short Creek near Covelo, Calif.	15.2	1958-64	1960	7.55	1,630	Dec. 22	[9] 9.20	3,600	20
				1955	1955	10.56	3,780				
497	11-4737	Mill Creek near Covelo, Calif.	96.9	1956-64	1960	15.15	10,000	Dec. 22	20.97	24,100	[2] 1.20
498	11-4738	Elk Creek near Hearst, Calif	84.1	1964	1964	6.65	1,440	Dec. 22	19.8	25,000	[2] 1.19
499	11-4739.8	Goforth Creek at Dos Rios, Calif.	3.83	1962-64	1963	15.66	483	Dec. 22	36.00	2,340	
500	11-4740	Eel River below Dos Rios, Calif.	1,484	1911-13, 1951-64.	1955	49.86	283,000	Dec. 22	62.5	460,000	[2] 1.83
501	11-4744.3	Salt Creek tributary near Zenia, Calif.	.18	1962-64	1962	51.66	8.8	Dec. 22	(3)	200	
502	11-4745	North Fork Eel River near Mina, Calif.	250	1953-64	1955	24.00	58,400	Dec. 22	33.6	133,000	[2] 2.15
503	11-4745.7	Wilson Creek near Mina, Calif.	2.84	1962-64	1962	13.55	250	Dec. 22	18.35	648	
504	11-4750	Eel River at Alderpoint, Calif.	2,079	1955-64	1955	72.5	376,000	Dec. 22	87.2	561,000	[2] 1.52
505	11-4755	South Fork Eel River near Branscomb, Calif.	43.9	1946-64	1955	16.20	20,100	Dec. 22	16.05	19,700	36
506	11-4755.6	Elder Creek near Branscomb, Calif.	6.39					Dec. 22		3,660	
507	11-4756.9	Steep Creek near Laytonville, Calif.	2.90	1962-64	1963	22.67	1,020	Dec. 22	25.30	1,220	
508	11-4757	Tenmile Creek near Laytonville, Calif.	50.3	1957-64	1960	19.14	12,200	Dec. 22	21.3	14,500	11
				1955	1955	22.9	16,300				
509	11-4758	South Fork Eel River at Leggett, Calif.	248					Dec. 22		78,700	(3)
510	11-4759	Squaw Creek near Garberville, Calif.	.26	1963-64	1964	(3)	124	Dec. 22	53.80	87	
511	11-4765	South Fork Eel River near Miranda, Calif.	537	1940-64	1955	42.7	173,000	Dec. 22	46.0	199,000	[2] 1.42

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Maximum flood previously known: Year	Maximum flood previously known: Gage height (ft)	Maximum flood previously known: Discharge (cfs)	Maximum December 1964 and January 1965: Day	Maximum December 1964 and January 1965: Gage height (ft)	Maximum December 1964 and January 1965: Discharge: Cfs	Maximum December 1964 and January 1965: Discharge: Recurrence interval (yr)
		North-coastal California—Continued									
		Eel River basin—Continued									
512	11-4766	Bull Creek near Weott, Calif.	28.1	1960–64	1963		4,120	Dec. 22	20.6	6,520	4
					1961	16.88					
513	11-4767	Larabee Creek near Holmes, Calif.	81.4	1959–64	1960	12.40	10,000	Dec. 22	13.05	11,400	3
514	11-4770	Eel River at Scotia, Calif.	3,113	1910–64	1955	61.90	541,000	Dec. 23	72.0	752,000	[2] 1.47
515	11-4775	Van Duzen River near Dinsmores, Calif.	85.1	1953–58, 1963–64.	1955	[1] 19.25	21,400	Dec. 22	22.5	27,000	24
516	11-4777	South Fork Van Duzen River near Bridgeville, Calif.	36.2	1953–57, 1958–64.	1955	[1] 11.91	8,990	Dec. 22	18.70	13,600	25
517	11-4778.7	Little Larabee Creek tributary near Bridgeville, Calif	.39	1962–64	1964	52.70	33	Dec. 22	55.80	126	
518	11-4784	Van Duzen River tributary near Bridgeville, Calif.	.71	1962–64	1962	53.55	56	Dec. 22	56.74	120	
519	11-4785	Van Duzen River near Bridgeville, Calif.	216	1950–64	1955	21.3	43,500	Dec. 22	22.6	48,700	[20] 1.13
520	11-4788	South Fork Yager Creek near Bridgeville, Calif.	.53	1961–64	1964	53.93	123	Dec. 22	56.56	236	
521	11-4790	Yager Creek near Carlotta, Calif.	127	1953–60	1955	[1] 17.4	28,000	Dec. 22	19.9	30,000	23
		Elk River basin:									
522	11-4797	Elk River near Falk, Calif.	44.2	1957–64	1959	27.62	3,220	Dec. 22	28.09	3,430	2
		Jacoby Creek basin:									
523	11-4800	Jacoby Creek near Freshwater, Calif.	6.07	1954–64	1954	7.20	1,670	Dec. 22	6.83	1,530	
		Mad River basin:									
524	11-4805	Mad River near Forest Glen, Calif.	143	1953–64	1955	24.5	39,200	Dec. 22	16.80	[6] 20,100	5
525	11-4807	Maple Creek near Blue Lake, Calif.	12.1	1961–64	1964	45.52	1,850	Dec. 22	47.05	3,100	(3)
526	11-4807.5	Mad River near Kneeland, Calif.	352					Dec. 22		55,000	(3)
527	11-4808	North Fork Mad River near Korbel, Calif.	40.5	1957–64	1964	15.75	8,400	Dec. 22	20.02	15,400	28
528	11-4810	Mad River near Arcata, Calif.	485	1910–13, 1950–64.	1955	[1] 27.30	77,800	Dec. 23	23.40	[6] 70,400	[16] 27
		Little River basin:									
529	11-4812	Little River at Crannell, Calif.	44.4	1955–64	1964	10.38	7,930	Dec. 22	11.06	8,240	[16] 17
				1953	1953	15.7					
		Big Lagoon basin:									
530	11-4813	Big Lagoon tributary near Trinidad, Calif.	.10	1961–64	1963	50.65	2.4	Dec. 22	50.77	3	

		Redwood Creek basin:									
531	11-4815	Redwood Creek near Blue Lake, Calif.	67.6	1953-58	1955		12,100	Dec. 22	16.05	16,400	9
					1953	15.3					
532	11-4824	Prairie Creek tributary near Klamath, Calif.	.40	1961-64	1964	51.94	50	Dec. 22	51.63	40	
533	11-4825	Redwood Creek at Orick, Calif.	278	1911-13, 1953-64.	1953, 1955	23,95	50,000	Dec. 22	24.0	50,500	[16] 29
		Dry Lake basin:									
534	11-4887	Dry Lake tributary at Perez, Calif.	1.74	1962-64	1962	6.44	128	Jan. 24	4.99	88	
		Butte Valley basin:									
535	11-4893.5	Horsethief Creek near Macdoel, Calif.	9.98	1962-64	1963	5.29	78	Dec. 22	8.35	635	
536	11-4895	Antelope Creek near Tennant, Calif.	18.6	1952-64	1962	4.31	538	Dec. 22	[9] 4.00	638	29
		Klamath River basin:									
537	11-4918	Mosquito Creek neat Shevlin, Oreg.	2.4	1964				Dec. 22	9.34	42	
538	11-4922	Crater Lake near Crater Lake, Oreg.	26.2	1878-1964	1958	[4] 6,179.06		Feb. 1	[4] 6,178.5		
539	11-4935	Williamson River near Klamath Agency, Oreg.	1,290	1908-10, 1954-64.	1910	3.7	1,590	Dec. 27	5.42	1.000	2
540	11-4948	Brownsworth Creek near Bly, Oreg.	2.20	1964				Dec. 22	12.85	66	
541	11-4975	Sprague River near Beatty, Oreg.	513	1912-26, 1953-64.	1955	9.44	3,340	Dec. 23	12.19	6,980	36
542	11-4978	Currier Creek near Paisley, Oreg.		1964				Dec. 22	15.21	116	
543	11-5010	Sprague River near Chiloquin, Oreg.	1,580	1920-64	1943	7.47	6,650	Dec. 26	10.37	14,900	[2] 2.13
544	11-5013	Crystal Creek near Chiloquin, Oreg.	5.77	1964				Dec. 22	14.89	65	
545	11-5025	Williamson River below Sprague River, near Chiloquin, Oreg.	3,000	1917-64	1943	7.29	7,660	Dec. 26	10.56	16,100	[2] 1.35
546	11-5044	Threemile Creek near Crystal, Oreg.	9.47	1964				Dec. 22	16.10	556	
547	11-5070	Upper Klamath Lake near Klamath Falls, Oreg.	3,810	1904-64	1904	[4] 4,144.98		Dec. 31	[4] 4,143,.72		
548	11-5075	Link River at Klamath Falls, Oreg.	3,810	1904-64	1904	[1] 7.30	[6] 9,400	Jan. 2		[6] 6,940	
549	11-5094	Klamath River tributary near Keno, Oreg.	1.02	1963-64				Dec. 23	13.62	18	
550	11-5095	Klamath River at Keno, Oreg.	3,920	1904-13, 1929-64.	1958	11.20	[6] 7,470	Feb. 1	11.85	[6] 8,480	
				1904	1904	[1] 15.3	9,250				
551	11-5107	Klamath River below John C. Boyle powerplant, near Keno, Oreg.	4,080	1959-64	1963	7.16	[6] 5,420	Feb. 1	8.55	[6] 8,830	
552	11-5145	Keene Creek near Ashland, Oreg.	12.1	1917-22, 1948-64.	1954	5.33	[6] 751	Feb. 2	3.33	[6] 84	
553	11-5165.3	Klamath River below Iron Gate Dam, Calif.		1960-64	1962	7.72	[6] 10,600	Dec. 22	13.63	[6] 29,400	
554	11-5166	Cottonwood Creek at Hornbrook, Calif.	89.8	1964	1964	2.32	61	Dec. 22	[9] 10.94	5,480	[2] 1.46
555	11-5169	Little Shasta River near Montague, Calif.	48.2	1957-64	1957	4.76	741	Dec. 22	10.2	5,910	([3])
556	11-5175	Shasta River near Yreka, Calif.	793	1933-41, 1944-64.	1955	9.43	6,090	Dec. 22	[9] 12.92	21,500	[2] 2.55

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		North-coastal California—Continued									
		Klamath River basin—Continued									
557	11-5178	Beaver Creek near Klamath River, Calif.	106	1955–56, 1959–64.	1956	10.6	8,000	Dec. 21	10.6	7,700	20
558	11-5178.4	Dona Creek near Klamath River, Calif.	2.90	1960–64	1962	6.50	20	Dec. 22	[7] 14.4	83	
559	11-5180.5	East Fork Scott River at Callahan, Calif.	110	1959–64	1962	9.05	4,530	Dec. 22	[9] 9.93	7,480	41
560	11-5183.1	Cedar Gulch near Callahan, Calif.	.99	1960–64	1962, 1964.	8.25	69	Dec. 22	10.18	144	
561	11-5184	Etna Creek above Lunch Creek, near Etna, Calif.	.80	1960–64	1961	9.50	51	Dec. 22	(3)	509	
562	11-5186	Moffett Creek near Fort Jones, Calif.	69.8	1958–64	1962	4.57	486	Dec. 23	[9] 5.59	680	(3)
563	11-5186.1	Soap Creek tributary near Fort Jones, Calif.	.42	1960–64	1962	10.32	9.1	Dec. 22	10.46	11	
564	11-5195	Scott River near Fort Jones, Calif.	653	1941–64	1955	21.40	38,500	Dec. 22	25.34	54,600	[2] 1.54
565	11-5205	Klamath River near Seiad Valley, Calif.	6,980	1912–25, 1951–64.	1955	29.2	[6] 122,000	Dec. 23	33.75	[6] 165,000	
566	11-5205.2	Fort Goff Creek near Seiad Valley, Calif.	13.0	1960–64	1962	15.53	700	Dec. 22	21.70	2,820	(3)
567	11-5215	Indian Creek near Happy Camp, Calif.	118	1911–21, 1956–64.	1959	23.54	14,400	Dec. 22	36.59	39,000	[2] 2.05
				1955	1955	29.0	23,000				
568	11-5222.1	Benjamin Creek near Happy Camp, Calif.	1.19	1960–64	1964	12.22	38	Dec. 22	12.56	146	
569	11-5222.6	Ti Creek near Somesbar, Calif.	9.46	1960–64	1964	3.29	550	Dec. 22	(3)	16,000	
570	11-5223	South Fork Salmon River near Forks of Salmon, Calif.	252	1953–64	1955	18.86	24,200	Dec. 22	21.73	31,400	[2] 1.27
571	11-5224	North Fork Salmon River near Forks of Salmon, Calif.	203	1958–64	1962	14.27	10,500	Dec. 22	28.2	30,000	[2] 1.21
572	11-5225	Salmon River at Somesbar, Calif.	746	1911–15, 1927–64.	1955	28.80	84,000	Dec. 22	43.4	133,000	[2] 1.66
573	11-5229	Wilson Creek near Orleans, Calif.	1.93	1961–64	1964	53.25	84	Dec. 22	(3)	6,500	
574	11-5230	Klamath River at Somesbar, Calif.	8,480	1927–64	1955	59.4	202,000	Dec. 22	76.5	307,000	(3)
575	11-5230.3	Red Cap Creek near Orleans, Calif.	56.1	1958–64	1962	10.69	5,340	Dec. 22		15,000	(3)
576	11-5230.5	Bluff Creek near Weitchpec, Calif.	74.6	1954–56, 1958–64.	1955	13.7	20,200	Dec. 22		27,000	[2] 1.17
577	11-5230.6	Aikens Creek tributary near Weitchpec, Calif.	.90	1961–64	1964	52.53	(3)	Dec. 22	54.03	142	
578	11-5231	Dan Rice Creek near Callahan, Calif.	1.11	1960–64	1961	7.61	58	Dec. 22	(3)	265	

579	11-5232	Trinity River above Coffee Creek, near Trinity Center, Calif.	149	1957-64	1958	10.50	12,800	Dec. 22	[9] 12.30	20,800	[2] 1.59
				1955	1955	10.5	11,400				
580	11-5237	Coffee Creek near Trinity Center, Calif.	107	1957-64	1962	5.72	3,360	Dec. 22	10.90	17,700	[2] 1.57
581	11-5253	Slate Creek near Trinity Alps, Calif.	2.30	1960-64	1962	12.22	114	Dec. 22	25.02	741	
582	11-5254	Clair Engle Lake near Lewiston, Calif.	692	1960-64	1963	[4] 2,376.02	[11] 2,548,600'	Jan. 31	[4] 2,348,94	[11] 2,118,000	
								Dec. 22		[13] 84,000	
583	11-5255	Trinity River at Lewiston, Calif.	728	1911-64	1955	[1] 27.3	71,600	Dec. 22	3.33	[6] 263	
584	11-5256.5	Tom Lang Gulch near Douglas City, Calif.	2.53	1960-64	1964	16.00	28	Dec. 22	16.50	56	
585	11-5258	Weaver Creek near Douglas City, Calif.	48.4	1959-64	1963	11.40	2,920	Dec. 22	12.72	3,980	(3)
586	11-5259	Browns Creek near Douglas City, Calif.	71.6	1957-64	1958	16.60	3,950	Dec. 22	[9] 16.29	3,790	3
587	11-5265	North Fork Trinity River at Helena, Calif.	151	1911-13, 1957-64.	1959	19.66	13,500	Dec. 22	27.93	35,800	[2] 1.99
588	11-5270	Trinity River near Burnt Ranch, Calif.	1,439	1931-40, 1956-64.	1958	30.50	81,500	Dec. 22	29.82	[6] 78,100	11
				1955	1955	43.2	172,000				
589	11-5270.1	Mill Creek near Burnt Ranch, Calif.	6.09	1960-64	1964	51.64	500	Dec. 22	60.29	5,000	
590	11-5274	New River at Denny, Calif.	173	1927-28, 1959-64.	1962	11.71	9,580	Dec. 22	38.7	60,000	[2] 2.73
591	11-5275.5	Panther Creek near Denny, Calif.	5.66	1960-64	1964	53.10	240	Dec. 22	(5)	14,000	
592	11-5281	South Fork Trinity River at Forest Glen, Calif.	208	1954-57, 1959-64.	1955	25.26	33,800	Dec. 22	27.7	41,200	[2] 1.75
593	11-5282	South Fork Trinity River near Hyampom, Calif.	342	1955-64	1955	[1] 22.2	39,400	Dec. 22	25.8	57,000	[2] 1.56
594	11-5284	Hayfork Creek near Hayfork, Calif.	86.7	1955-64	1960	11.67	4,210	Dec. 22	14.56	7,520	[20] 1.65
595	11-5284.4	Big Creek near Hayfork, Calif.	27.1	1960-61, 1962-64.	1964	9.64	773	Dec. 22	11.75	1,610	(3)
596	11-5284.8	Hayfork Creek tributary near Hyampom, Calif.	.93	1960-64	1964	53.15	45	Dec. 22	60.85	168	
597	11-5285	Hayfork Creek near Hyampom, Calif.	378	1953-64	1955	18.00	25,300	Dec. 22	19.14	28,800	[20] 1.08
598	11-5290	South Fork Trinity River near Sayler, Calif.	898	1911-13, 1950-64.	1955	39.4	65,100	Dec. 22	47.6	95,400	[20] 1.36
599		East Fork Willow Creek near Willow Creek, Calif.	11.9					Dec. 22		4,900	
600	11-5298	Willow Creek at Willow Creek, Calif.	43.3	1959-64	1964	9.86	5,260	Dec. 22	25.3	17,000	(3)
601	11-5299.5	Campbell Creek near Hoopa, Calif.	6.90	1961-64	1963	58.00	790	Dec. 22	78.35	2,420	
602	11-5300	Trinity River near Hoopa, Calif	2,847	1911-14, 1916-18, 1931-64.	1955	36.90	190,000	Dec. 22	40.3	[6] 231,000	[20] 1.24
603	11-5301.5	Mareep Creek near Weitchpec, Calif.	3.56	1961-64	1962, 1964	54.24	191	Dec. 22	58.64	890	
604	11-5303	Blue Creek near Klamath, Calif.	120					Dec. 22	21.55	48,000	(3)
605	11-5305	Klamath River near Klamath, Calif.	12,100	1910-26, 1950-64.	1955	49.7	425,000	Dec. 23	55.3	557,000	[20] 1.44
		Smith River basin:									
606	11-5308.5	Middle Fork Smith River tributary near O'Brien, Oreg.	.29	1961-64	1962	56.18	55	Dec. 22	65.70	102	
607	11-5309.5	Darlingtonia Creek at Darlingtonia, Calif.	.77	1961-64	1962	56.14	242	Dec. 22	55.80	212	

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Maximum flood previously known: Year	Maximum flood previously known: Gage height (ft)	Maximum flood previously known: Discharge (cfs)	Maximum December 1964 and January 1965: Day	Maximum December 1964 and January 1965: Gage height (ft)	Maximum December 1964 and January 1965: Discharge: Cfs	Maximum December 1964 and January 1965: Discharge: Recurrence interval (yr)
		North-coastal California—Continued									
		Smith River basin—Continued									
608	11-5310	Middle Fork Smith River at Gasquet, Calif.	130	1911–18, 1953–56, 1958–64.	1955	[1] 11.5	26,000	Dec. 22	22.2	41,100	[2] 1.14
609	11-5320	South Fork Smith River near Crescent City, Calif.	291	1911–13, 1954–64.	1955	36.95	108,000	Dec. 22	43.8	162,000	[2] 2.19
610	11-5325	Smith River near Crescent City, Calif.	609	1931–64	1955	41.20	165,000	Dec. 22	48.5	228,000	[2] 1.90
		Lopez Creek basin:									
611	11-5330	Lopez Creek near Smith River, Calif.	.93	1961–64	1963	3.68	330	Dec. 22	2.42	84	....
		Minor area of flooding in Washington									
		Puyallup River basin:									
612	12-0935	Puyallup River near Orting, Wash	172	1931–64	1962	....	15,300	Jan. 29	6.11	12,200	24
					1959	[9] 7.25	....	....	....	....	....
613	12-0950	South Prairie Creek at South Prairie, Wash.	79.5	1949–64	1955	9,78	6,850	Jan. 29	9.48	6,400	[2] 1.04
614	12-0970	White River at Greenwater, Wash	216	1911–12, 1929–64.	1933	9.38	18,100	Jan. 29	7.85	10,400	28
615	12-0975	Greenwater River at Greenwater, Wash	73.5	1911–12, 1929–64.	1959	7.67	5,360	Jan. 29	7.52	5,090	[2] 1.58
616	....	East Twin Creek near Greenwater, Wash.	3.08	....	....	....	....	Jan. 29	....	705	[2] 1.76
617	....	West Twin Creek near Greenwater, Wash.	3.26	....	....	....	....	Jan. 29	....	1,680	[2] 3.98
618	....	Scatter Creek near Enumclaw, Wash	9.75	....	....	....	....	Jan. 29	....	1,430	6
619	12-0980	Mud Mountain Reservoir near Buckley, Wash.	400	1943–64	1956	[4] 1,117.1	[11] 37,300	Jan. 31	[4] 1,130.0	[11] 44,130	....
620	12-0985	White River near Buckley, Wash	401	1928–33, 1938–64.	1932	[1] 17.5	17,000	Jan. 30	[4] 807.29	[6] 11,200	2
				1933	1933	[1] 23.4	28,000	....	....	....	....
621	12-0995	Boise Creek near Enumclaw, Wash	12.3	1945–46, 1962–64.	1964	5.15	432	Jan. 29	7.64	1,700	[2] 1.21
		Duwamish River basin:									
622	12-1045	Green River near Lester, Wash	96.2	1945–64	1959	[1] 16.0	22,000	Jan. 29	8.41	9,110	33

623	12-1055	Charley Creek near Eagle Gorge, Wash..	11.3	1946–55, 1964.	1953	6.6	2,440	Jan. 29	....	5,360	[2] 2.01
624	12-1060	Bear Creek near Eagle Gorge, Wash........	4.10	1946–56, 1960–64.	1955	4.46	1,010	Jan. 29	....	1,330	[2] 1.16
625	12-1072	Deep Creek near Cumberland, Wash........	2.17	1950–64......	1951	10.64	109	Jan. 29	11.35	128	[2] 1.11
		Upper Columbia River and Snake River basins									
		Spokane River basin:									
626	12-4110	Coeur d'Alene River above Shoshone Creek, near Prichard, Idaho.	335	1950–64......	1961	....	11,000	Dec. 23	8.37	11,900	23
					1963	[7] 11.55	....	....	....	....	....
627	12-4130	Coeur d'Alene River at Enaville, Idaho..	895	1911–13, 1939–64.	1961	76.33	31,500	Dec. 23	77.15	34,800	26
				1933...........	1933	79.47	(3)	....	....	....	....
628	12-4131	Boulder Creek at Mullan, Idaho........	3.13	1961–64......	1964	15.53	144	Dec. 23	14.97	109	....
629	12-4132	Montgomery Creek near Kellogg, Idaho.	4.53	1962–64......	1962	4.69	147	Dec. 23	5.11	140	....
630	12-4133	Pine Creek at Pinehurst, Idaho........	74.0	....	....	....	....	Dec. 23	....	5,290	[2] 1.77
631	12-4135	Coeur d'Alene River near Cataldo, Idaho.	1,220	1911–12, 1920–64.	1933	56.9	67,000	Dec. 23	53.87	47,200	45
632	12-4145	St. Joe River at Calder, Idaho...............	1,030	1911–12, 1920–64.	1933	....	53,000	Dec. 23	90.04	30,400	15
					1938	93.1	....	....	....	....	....
633	12-4150	St. Maries River at Lotus, Idaho.............	437	1911–12, 1920–64.	1933	....	23,800	Dec. 23	15.0	22,000	[2] 1.91
					1951	[7] 13.4	....	....	....	....	....
634	12-4151	Cherry Creek near St. Maries, Idaho........	7.07	1961–64......	1961	8.75	92	Dec. 23	11.09	247	....
635	12-4152	Plummer Creek tributary at Plummer, Idaho.	2.10	1961–64......	1963	[7] 8.83	70	Dec. 23	9.47	122	....
636	12-4155	Coeur d'Alene Lake at Coeur d'Alene, Idaho.	3,700	1903–64......	1933	[4] 2,139.05	[5] 834,900	Dec. 26	[4] 2,133.03	[5] 501,600	....
637	12-4160	Hayden Creek below North Fork, near Hayden Lake, Idaho.	22.0	1948–53, 1959, 1962–64.	1950	[1] 4.73	774	Dec. 23	4.15	790	10
638	12-4170	Hayden Lake at Hayden Lake, Idaho	62.3	1920–64......	1956	42.46	....	Jan. 12	38.44	....	....
639	12-4190	Spokane River near Post Falls, Idaho.. ...	[19] 3,840	1912–64......	1933	....	[6] 50,100	Dec. 26	21.31	[6] 30,900	....
640	12-4235.5	Hangman Creek tributary near Latah, Wash.	2.18	1961–64......	1963	10.82	155	Dec. 23	9.02	46	....
		Yakima River basin:									
641	12-5106	Webber Canyon near Kiona, Wash..........	2.88	1955–64......	1956	13.36	154	Jan. 29	12.53	116	....
642	12-5107	Yakima River tributary near Kiona, Wash.	3.35	1955–64......	1956, 1957	....	2	Dec. 22	15.55	2	....
		Columbia River main stem:									
643	12-5140	Columbia River at Pasco, Wash........	104,000	1962–64.....	1964	[4] 346.09	[6] 469,000	Feb. 11	[4] 339.75	[6] 148,000	....
		Snake River main stem:									
644	13-0600	Snake River near Shelley, Idaho..	[10] 9,790	1915–64.....	1918	16.97	[6] 47,200	Dec. 25	7.08	[6] 6,570	....
				1894......	1894	....	75,000	....	....	....	....

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		Upper Columbia River and Snake River basins—Continued									
		Blackfoot River basin:									
645	13-0685	Blackfoot River near Blackfoot, Idaho	1,295	1913-64	1962	7.68	[12] 1,710	Dec. 25		[12] 495	
		Snake River main stem:									
646	13-0695	Snake River near Blackfoot, Idaho	[10] 11,310	1910-64	1918	[1] 14.80	[6] 46,200	Dec. 26	5.78	[6] 6,310	
		Portneuf River basin:									
647	13-0730	Portneuf River at Topaz, Idaho	570	1913-15, 1919-64.	1963	8.22	[6] 7,120	Dec. 23	6.00	[6] 1,740	[2] 2.01
648	13-0737	Robbers Roost Creek near McCammon, Idaho.	5.7	1961-64	1964	7.38	18	Dec. 22	6.81	5	
649	13-0750	Marsh Creek near McCammon, Idaho	355	1954-64	1962	13.25	1,120	Dec. 23	7.14	433	[2] 1.31
650	13-0753	East Fork Mink Creek near Pocatello, Idaho.	14.7	1963-64	1963	6.39	49	Dec. 23	5.32	12	<2
651	13-0755	Portneuf River at Pocatello, Idaho	1,250	1897-99, 1911-64.	1962	11.35	[6] 2,990	Dec. 25-26	6.96	[6] 1,020	8
652	13-0756	North Fork Pocatello Creek near Pocatello, Idaho.	14.0	1961-64	1962	8.85	50	Dec. 22	6.98	16	3
653	13-0757	South Fork Pocatello Creek near Pocatello, Idaho.	4.3	1960-64	1962	1.69	6.2	Dec. 22	1.18	1.6	
		Bannock Creek basin:									
654	13-0760	Bannock Creek below Moonshine Creek, near Pocatello, Idaho.	230	1955-58, 1962-64.	1963		4,600	Dec. 23		7,790	(3)
655	13-0762	Bannock Creek at Union Pacific Railroad, near Pocatello, Idaho.	413	1962-64	1962		4,010	Dec. 24		3,100	
		Snake River main stem:									
656	13-0765	American Falls Reservoir at American Falls, Idaho.	[10] 13,580	1926-64	1963	[4] 4,355.34	[11] 1,748,000	Jan. 31	[4] 4,345.75	[11] 1,245,000	
657	13-0770	Snake River at Neeley, Idaho	[10] 13,600	1906-64	1918	[1] 13.5	[6 8] 48,400	Dec. 31	5.18	[6] 5,990	
		Rock Creek basin:									
658	13-0774	Rock Creek above old gage, near Rockland, Idaho.	156	1947, 1963.	1963		5,100	Dec. 23		3,750	
659	13-0776.5	Rock Creek at U.S. Highway 30N, near American Falls, Idaho.	320	1962	1962		3,300	Dec. 23		7,950	

		Raft River basin:									
660	13-0792	Cassia Creek near Elba, Idaho	84	1956-64	1964	5.13	325	Dec. 23	7.62	982	[2] 2.25
661	13-0798	Heglar Canyon tributary near Rockland, Idaho.	7.72	1958, 1962-64.	1958	17.54	1,930	Dec. 23	11.58	290	
		Main Drain basin:									
662	13-0848	"D" Main Drain tributary near Rupert, Idaho.	5.0					Dec. 23		86	
663	13-0849	"F" Main Drain near Rupert, Idaho	64.7					Dec. 23		2,990	
		Snake River main stem:									
664	13-0880	Snake River at Milner, Idaho	[10] 17,180	1909-64	1918	[1] 19.9	[6] 40,000	Jan. 26	12.70	[6] 8,530	
		Rock Creek basin:									
665	13-0920	Rock Creek near Rock Creek, Idaho	80	1909-13, 1938-39, 1943-64.	1964	3.47	429	Dec. 24	3.20	255	2
		Snake River main stem:									
666	13-1350	Snake River below Lower Salmon Falls, near Hagerman, Idaho.		1937-64	1964	15.73	[6] 31,200	Jan. 28	12.09	[6] 19,500	
		Big Wood River basin:									
667	13-1410	Big Wood River near Bellevue, Idaho	823	1911-64	1956		4,130	Dec. 24	4.37	723	<2
					1958	6.43					
668	13-1415	Camas Creek near Blaine, Idaho	648	1912-64	1943		[6] 9,780	Dec. 27	10.57	[6] 3,600	3
					1963	16.2					
669	13-1420	Magic Reservoir near Richfield, Idaho	1,600	1909-64	1951	135.7	[5] 194,200	Jan. 19	123.7	[5] 151,000	
670	13-1425	Big Wood River below Magic Dam, near Richfield, Idaho.	1,600	1911-64	1952	15.68	[6] 10,000	Jan. 20	6.14	[6] 2,080	
671	13-1457	Schooler Creek near Gooding, Idaho	2.22	1961-64	1963	5.90	68	Dec. 22	4.20	43	
672	13-1459	Preacher Creek near Gooding, Idaho	26	1962	1962		646	Dec. 23		2,210	
673	13-1465	Big Wood River at Gooding, Idaho	2,190	1896, 1898-99, 1921-48, 1963.	1963	11.6	[6] 6,300	Dec. 22	9.90	[6] 4,900	
674	13-1471	Dry Creek near Gooding, Idaho	84	1962	1962		1,390	Dec. 22 or 24		8,050	
675	13-1479	Little Wood River above High Five Creek, near Carey, Idaho.	248	1958-64	1962	5.14	1,340	Dec. 23	6.20	2,090	30
676	13-1482	Little Wood Reservoir near Carey, Idaho.	279	1955-64	1963	138.99	[11] 30,940	Jan. 8	119.89	[11] 20,830	
677	13-1485	Little Wood River near Carey, Idaho	312	1904-5, 1926-64.	1938	12.81	[6] 6,000	Dec. 23	8.69	[6] 2,400	
678	13-1510	Little Wood River near Richfield, Idaho	570	1911-64	1938	[1] 3.97	868	Dec. 24	5.01	[6] 755	
679	13-1511	Jim Byrnes Slough at Richfield, Idaho		1962-64	1962		1,520	Dec. 23		1,600	
680	13-1525	Big Wood River near Gooding, Idaho	2,990	1916-64	1963	11.89	[6] 8,440	Dec. 22	12.15	[6] 8,8[illegible]0	
		Clover Creek basin:									
681	13-1538	Clover Creek above Calf Creek, near Bliss, Idaho.	71.2	1963-64	1963		5,680	Dec. 23		7,000	

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Maximum flood previously known: Year	Maximum flood previously known: Gage height (ft)	Maximum flood previously known: Discharge (cfs)	Maximum December 1964 and January 1965: Day	Maximum December 1964 and January 1965: Gage height (ft)	Maximum December 1964 and January 1965: Discharge: Cfs	Maximum December 1964 and January 1965: Discharge: Recurrence interval (yr)
		Upper Columbia River and Snake River basins—Continued									
		Clover Creek basin—Continued									
682	13-1539	Calf Creek near Bliss, Idaho	39.4	1963-64	1963		4,150	Dec. 23		6,400	
683	13-1544	Clover Creek near King Hill, Idaho	265					Dec. 23		10,100	
		Snake River main stem:									
684	13-1545	Snake River at King Hill, Idaho	35,800	1909-64	1918	16.3	[6] 47,200	Dec. 23	13.20	[6] 31,900	10
		Little Canyon Creek basin:									
685	13-1552	Burns Gulch near Glenns Ferry, Idaho	.76	1961-64	1963	7.73	22	Dec. 23	8.87	17	
686	13-1553	Little Canyon Creek at Stout Crossing, near Glenns Ferry, Idaho.	14.2	1961-64	1963	12.33	196	Dec. 23	14.72	500	39
687	13-1554	Little Canyon Creek at Berry Ranch, near Glenns Ferry, Idaho.	26.9	1960-64	1963	4.60	519	Dec. 23	6.21	1,330	(3)
		Bruneau River basin:									
688	13-1685	Bruneau River near Hot Spring, Idaho	2,630	1909-15, 1943-64.	1910	13.0	6,500	Dec. 25	9.37	3,330	8
		Fossil Creek basin:									
689	13-1722	Fossil Creek near Oreana, Idaho	19.7	1961-64	1961	16.2	100	Dec. 23	16.88	195	7
		Sinker Creek basin:									
690	13-1723	Sinker Creek near Murphy, Idaho	74	1962-64	1962		774	Dec. 23		1,500	(3)
		Snake River main stem:									
691	13-1725	Snake River near Murphy, Idaho	41,900	1912-64	1918	[1] 13.95	[6] 47,300	Dec. 24	12.30	[6] 38,300	25
		Squaw Creek basin:									
692	13-1728	Little Squaw Creek tributary near Marsing, Idaho.	1.81	1961-64	1963	10.78	93	Dec. 23	8.73	55	
		Succor (Sucker) Creek basin:									
693	13-1735	Succor Creek at Homedale, Idaho	413	1903-9, 1963.	1963		13,300	Dec. 23		2,450	(3)
		Owyhee River basin:									
694	13-1745	Owyhee River near Gold Creek, Nev	209	1916-25, 1936-64.	1922	10.11	1,810			No flow	
695	13-1760	Owyhee River above China diversion dam, near Owyhee, Nev.	458	1939-64	1952	10.07	2,710	Dec. 24	8.13	944	2

696	13-1769	Jack Creek below Schoonover Creek, near Tuscarora, Nev.	19.8	1962-64	1963	2.38	162	Dec. 23	1.65	74	<2
697	13-1772	South Fork Owyhee River at Spanish Ranch, near Tuscarora, Nev.	330	1959-64	1962	7.40	4,130	Jan. 31	4.09	354	<2
698	13-1778	South Fork Owyhee River near White-rock, Nev.	1,080	1955-64	1963	7.55	[6] 3,830	Jan. 31	4.40	[6] 1,110	<2
699	13-1780	Jordan Creek above Lone Tree Creek, near Jordan Valley, Oreg.	440	1945-53, 1955-64.	1952	[1] 5.57	3,250	Dec. 24	11.05	7,530	[2] 1.96
700	13-1810	Owyhee River near Rome, Oreg	8,000	1949-64	1952	15.36	[6] 27,800	Dec. 24	16.7	[6] 33,500	[2] 1.23
701	13-1825	Lake Owyhee near Nyssa, Oreg	11,160	1932-64	1952	[4] 2,671.40	[11] 1,140,000	Feb. 3	[4] 2,669.07	[11] 1,110,000	
702	13-1830	Owyhee River below Owyhee Dam, Oreg.	11,160	1929-64	1952	15.7	[6] 22,900	Feb. 2	10.52	[6] 9,700	
		Boise River basin:									
703	13-1849.5	Sheep Creek near Arrowrock Dam, Idaho.	28.2					Dec. 23		3,590	
704	13-1850	Boise River near Twin Springs, Idaho	830	1911-64	1956	8.76	11,200	Dec. 23	12.20	18,800	[2] 1.55
705	13-1860	South Fork Boise River near Feather-ville, Idaho.	635	1945-64	1956	8.62	7,580	Dec. 23	7.36	6,810	8
706	13-1900	Anderson Ranch Reservoir at Anderson Ranch Dam, Idaho.	980	1945-64	1956	[4] 4,197.81	[5] 472,800	Jan. 18	[4] 4,186.08	[5] 418,600	
								Dec. 23		[14] 9,840	
707	13-1905	South Fork Boise River at Anderson Ranch Dam, Idaho.	982	1943-64	1956	10.56	[6] 9,850	Jan. 18	6.76	[6] 3,610	
708	13-1924	Rattlesnake Creek near Arrowrock Dam, Idaho.	37.8					Dec. 23		1,320	
709	13-1930	Willow Creek near Arrowrock Dam, Idaho.	57.0	1916-17	1917	1.95	234	Dec. 23		1,820	
710	13-1940	Arrowrock Reservoir at Arrowrock Dam, Idaho.	2,210	1917-64	1948	[4] 3,219.1	[5] 301,200	Jan. 15	[4] 3,215.0	[5] 283,500	
								Dec. 23		[14] 33,900	
711	13-1965	Bannock Creek near Idaho City, Idaho	5.75	1939-41, 1950-64.	1958		34	Dec. 23	1.58	20	
					1952	[7] 2.03					
712	13-2000	Mores Creek above Robie Creek, near Arrowrock Dam, Idaho.	399	1950-64	1955	9.55	5,440	Dec. 23	9.53	5,360	(3)
713	13-2005	Robie Creek near Arrowrock Dam, Idaho.	15.8	1950-64	1955	2.67	163	Jan. 29	3.07	274	[2] 1.29
714	13-2015	Lucky Peak Reservoir near Boise, Idaho	2,680	1954-64	1955	[4] 3,059.32	[11] 305,130	Jan. 12	[4] 2,998.81	[11] 160,410	
715	13-2020	Boise River near Boise, Idaho	2,680	1895-1916, 1954-64.	1896		35,500	Jan. 31		[6] 4,560	
716	13-2050	Cottonwood Gulch at Boise, Idaho	16.0	1939-41, 1959-64.	1959		[1] 1,580	Jan. 28 or 29		152	4
717	13-2070	Spring Valley Creek near Eagle, Idaho	20.9	1954-59, 1960-64.	1957	2.85	244	Jan. 29	2.74	214	(3)
718	13-2075	Dry Creek near Eagle, Idaho	59.4	1954-64	1957	4.70	339	Jan. 29	4.48	373	(3)
719	13-2103	Bryans Run near Boise, Idaho	7.03	1961-64	1963	11.24	142	Jan. 28	11.30	285	
720	13-2125	Boise River at Notus, Idaho	3,820	1920-64	1943	10.43	[6] 20,500	Jan. 29		[6 8] 5,910	
		Malheur River basin:									
721	13-2139	Malheur River tributary near Drewsey, Oreg.	2.29	1964	1964	10.88	100	Dec. 22	9.54	42	

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		Upper Columbia River and Snake River basins—Continued									
		Malheur River basin—Continued									
722	13-2140	Malheur River near Drewsey, Oreg.	910	1920–23, 1926–64.	1957	13.20	10,700	Dec. 23	13.50	12,000	[2] 1.74
723	13-2150	Malheur River below Warmsprings Reservoir, near Riverside, Oreg.	1,100	1909–10, 1915–17, 1919–64.	1910	[1] 10.7	7,200	Feb. 27		[6,8] 259	
724	13-2165	North Fork Malheur River above Agency Valley Reservoir near Beulah, Oreg.	355	1914, 1936–64.	1963	5.78	2,060	Dec. 23	8.30	3,970	[2] 2.01
725	13-2175	North Fork Malheur River at Beulah, Oreg.	440	1926–64	1942	8.4	[23] 7,000	Feb. 3, 4		[6,3] 798	
726	13-2200	Malheur River at Little Valley, near Hope, Oreg.	3,010	1949–64	1957	11.5	[6] 12,300	Jan. 29	9.52	[6] 8,540	
727	13-2265	Bully Creek at Warmsprings, near Vale, Oreg.	539	1903–07, 1910–17, 1922–23, 1963–64.	1910	[1] 8.6	6,240	Dec. 22	8.68	12,800	[2] 3.31
		Payette River basin:									
728	13-2343	Fivemile Creek near Lowman, Idaho	7.8	1962–64	1963	17.77	186	Dec. 23	17.54	175	
729	13-2350	South Fork Payette River at Lowman, Idaho.	456	1941–64	1956	7.45	7,050	Dec. 23	6.60	5,280	3
730	13-2351	Rock Creek at Lowman, Idaho	14.6	1962–64	1964	6.75	100	Dec. 23	8.67	200	
731	13-2360	Deadwood Reservoir near Lowman, Idaho.	112	1935–64	1943	[4] 5,337.1		Jan. 31	[4] 5,309.46		
732	13-2365	Deadwood River below Deadwood Reservoir, near Lowman, Idaho	112	1926–64	1953		[6] 2,580	Jan. 29–31		[6,8] 2.7	
					1956	8.93					
733	13-2373	Danskin Creek near Grimes Pass, Idaho	10.1	1962–64	1962	10.99	44	Dec. 23	11.35	54	
734	13-2376	Cabin Creek near Smiths Ferry, Idaho	.42	1960–64	1962	1.78	3.8	Dec. 22	1.97	7.7	
735	13-2377	Control Creek near Smiths Ferry, Idaho	.59	1963–64	1964	2.23	1.8	Dec. 22	2.63	10	
736	13-2378.2	Lightning Creek near Crouch, Idaho	24.4					Dec. 23		864	
737	13-2380	Payette River near Banks, Idaho	1,200	1921–64	1927	10.6	13,800	Dec. 23	15.46	20,800	[2] 1.06
738	13-2445	Cascade Reservoir at Cascade, Idaho	620	1948–64	1957	[4] 4,828.89	[11] 727,000	Jan. 12	[4] 4,820.30	[11] 515,100	
					1955		[14] 11,000	Dec. 22		[14] 18,000	
739	13-2450	North Fork Payette River at Cascade, Idaho.	620	1941–64	1947	[1] 6.29	[6] 7,320	Jan. 13	8.60	[6] 1,730	
740	13-2460	North Fork Payette River near Banks, Idaho.	933	1947–64	1947	13.5	[6] 8,830	Dec. 23	11.93	[6] 6,700	2

741	13-2475	Payette River near Horseshoe Bend, Idaho.	2,230	1906-16, 1919-64.	1921	[1] 9.57	[6] 22,100	Dec. 23	16.35	[6] 27,000	16
742	13-2489	Cottonwood Creek near Horseshoe Bend, Idaho.	6.53	1961-64	1963	16.81	303	Jan. 29	13.64	142	....
743	13-2492	Squaw Creek near Sweet, Idaho	345	1955-64	1955	....	4,970	Dec. 22	....	12,000	....
744	13-2495	Payette River near Emmett, Idaho	2,680	1925-64	1938	....	[6] 22,800	Dec. 23	15.88	[6] 32,700	....
					1955	12.98	....	....	....	....	....
745	13-2506	Big Willow Creek near Emmett, Idaho	47.4	1961-64	1962	5.23	882	Dec. 22	7.61	1,860	....
				1957	1957	....	2,100	....	....	....	....
746	13-2506.5	Fourmile Creek near Emmett, Idaho	6.5	1962-64	1962	4.80	160	Dec. 22	5.70	500	....
747	13-2510	Payette River near Payette, Idaho	3,240	1935-64	1938	....	[6] 23,400	Dec. 24	13.80	[6] 30,900	....
					1955	12.75	....	....	....	....	....
		Weiser River basin:									
748	13-2515	Weiser River at Tamarack, Idaho	36.5	1936-64	1955	[1] 7.17	1,320	Dec. 24	4.56	423	<2
749	13-2585	Weiser River near Cambridge, Idaho	605	1939-64	1955	[1] 13.9	10,100	Dec. 22	[7] 10.90	8,500	35
750	13-2610	Little Weiser River near Indian Valley, Idaho.	81.9	1920-21, 1923-27, 1938-64.	1925	....	1,840	Dec. 22	6.08	1,480	22
751	13-2645	Crane Creek near Midvale, Idaho	242	1910-16, 1924-64.	1910	[1] 9.4	4,750	Dec. 27, 28	5.04	[6] 900	....
752	13-2655	Crane Creek at mouth, near Weiser, Idaho.	288	1920-64	1957	6.23	[6] 3,170	Jan. 29	5.47	[6] 1,960	[2] 1.20
753	13-2660	Weiser River near Weiser, Idaho	1,460	1890-91, 1894-1904, 1910-14, 1952-64.	1955	....	[6] 19,900	Dec. 23	10.50	[6] 17,200	....
					1961	[7] 12.83	....	....	....	....	....
754	13-2670	Mann Creek near Weiser, Idaho	56	1911-13, 1920, 1937-64.	1940	[1] 5.45	1,540	Dec. 23	4.72	900	39
755	13-2671	Deer Creek near Midvale, Idaho	4.60	1962-64	1963	15.16	115	Dec. 23	11.99	40	....
		Snake River main stem:									
756	13-2690	Snake River at Weiser, Idaho	69,200	1910-64	1952	[1] 14.67	[6] 84,500	Dec. 25	12.62	[6] 72,400	12
				1910	1910	[1] 17.1	120,000	....	....	....	....
		Moores Hollow basin:									
757	13-2692	Moores Hollow tributary near Weiser, Idaho.	.90	1963-64	1964	18.75	9.2	Jan. 29	18.93	12	....
		Burnt River basin:									
758	13-2693	North Fork Burnt River near Whitney, Oreg.	110	1964	1964	1.72	47	Jan. 30	3.62	823	5
759	13-2708	South Fork Burnt River above Barney Creek, near Unity, Oreg.	38.5	1963-64	1964	1.40	61	Jan. 30	....	122	<2
								Dec. 18	[7] [21] 3.11	....	....
760	13-2730	Burnt River near Hereford, Oreg	309	1915-16, 1928-64.	1943	[21] 7.85	[6] 2,220	Feb. 7	3.35	[6] 320	<2
761	13-2742	Burnt River near Bridgeport, Oreg	650	1956-64	1957	5.43	[6] 1,270	Feb. 7	3.68	[6] 539	<2
762	13-2750	Burnt River at Huntington, Oreg	1,093	1928-32, 1956-64.	1957	....	2,190	Dec. 22	5.94	2,220	2
					1963	[7] 6.80	....	....	....	....	....
		Powder River basin:									
763	13-2754	California Gulch near Baker, Oreg	3.44	1963-64	1964	6.77	15	Dec. 23	7.36	40	....

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known				Maximum December 1964 and January 1965			
				Period of record	Year	Gage height (ft)	Discharge (cfs)	Day	Gage height (ft)	Discharge: Cfs	Discharge: Recurrence interval (yr)
		Upper Columbia River and Snake River basins—Continued									
		Powder River basin—Continued									
764	13-2755	Powder River near Baker, Oreg...	219	1903-14, 1926-64.	1910	[1] 7.05	1,820	Jan. 30	5.59	1,150	18
765	13-2818	Antone Creek near North Powder, Oreg..	4.39	...	...	...	...	Jan. 30	11.98	144	...
766	13-2867	Powder River near Richland, Oreg...	1,310	1957-64...	1958	...	[6] 2,210	Jan. 31	6.68	[6] 3,470	<2
					1963	[7] 7.10	...				
767	13-2882	Eagle Creek above Skull Creek, near New Bridge, Oreg.	156	1957-64...	1958	...	2,690	Jan. 30	1.75	478	<2
					1962	[7] 6.88	...	...	...	...	...
768	13-2891	Immigrant Gulch near Richland, Oreg....	6.64	1963-64...	1964	7.19	89	Jan. 30	7.22	91	...
		Snake River main stem:									
769	13-2897	Brownlee Reservoir at Brownlee Dam, Idaho-Oreg. State line.	72,590	1958-64...	1962	[4]2,078.91	[11] 1,453,500	Dec. 25	[4] 2,077.42	[11] 1,432,600	...
770	13-2902	Snake River below Pine Creek, at Oxbow, Oreg.	73,150	1958-64...	1964	21.53	[6] 58,600	Dec. 25	25.07	[6] 76,800	5
				1952...	1952	[1] 23.10	89,700	...	...	...	...
771	13-2905	Snake River near Joseph, Idaho...	73,800	1955-64...	1957	21.5	76,700	Dec. 26	20.16	[6] 80,800	5
		Imnaha River basin:									
772	13-2920	Imnaha River at Imnaha, Oreg...	622	1928-64...	1957	6.80	6,650	Jan. 31	3.86	1,330	<2
		Salmon River basin:									
773	13-3165	Little Salmon River at Riggins, Idaho....	576	1951-55, 1956-64.	1958	...	6,720	Dec. 23	3.86	3,470	<2
					1953	7.39	...	...	...	...	...
				1948...	1948	...	9,200	...	...	...	...
774	13-3168	North Fork Skookumchuck Creek near White Bird, Idaho.	15.6	1959-64...	1964	4.46	471	Jan. 29	3.24	123	...
775	13-3170	Salmon River at White Bird, Idaho...	13,550	1910-17, 1919-64.	1956	33.05	106,000	...	...	...	...
					1894	37.5	120,000	Dec. 24	20.71	28,000	<2
776	13-3172	Johns Creek near Grangeville, Idaho ...	6.55	1961-64...	1964	14.07	247	Jan. 29	15.59	400	...
		Grande Ronde River basin:									
777	13-3190	Grande Ronde River at La Grande, Oreg.	678	1903-15, 1918-23, 1925-64.	1932	8.90	8,880	Jan. 30	11.44	14,100	[2] 1.91
778	13-3200	Catherine Creek near Union, Oreg...	105	1911-12, 1915, 1918-19, 1925-64.	1948	4.57	1,740	Jan. 29	2.85	665	<2
779	13-3223	Dry Creek near Bingham Springs, Oreg..	1.37	...	...	...	...	Jan. 30	30.58	50	...

780	13-3235	Grande Ronde River near Elgin, Oreg.	1,250	1955-64	1956	11.78	5,220	Feb. 2	13.79	6,480
				1948	1948	[1, 4] 2,672.9	5,690			
781	13-3250	East Fork Wallowa River near Joseph, Oreg.	10.3	1924-64	1937		450	Dec. 22		33	<2
782	13-3275	Wallowa River at Joseph, Oreg.	50.9	1903-15, 1926-64.	1957	4.75	[6] 1,200	Feb. 28	1.38	[6] 25	<2
783	13-3295	Hurricane Creek near Joseph, Oreg.	29.6	1915, 1924-64.	1948	3.55	1,110	Dec. 24	3.79	208	<2
784	13-3300	Lostine River near Lostine, Oreg.	70.9	1912-15, 1925-64.	1913	[1] 6.60	2,540	Dec. 23	2.91	442	<2
785	13-3305	Bear Creek near Wallowa, Oreg.	68	1915, 1924-64.	1936	3.82	1,620	Jan. 30	2.80	780	<2
786	13-3325	Grande Ronde River at Rondowa, Oreg.	2,555	1926-64	1948	9.76	19,900	Jan. 30	10.93	24,700	22
787	13-3330	Grande Ronde River at Troy, Oreg.	3,275	1944-64	1946	[1] 12.35	30,000	Dec. 23	11.25	42,200	[2] 1.08
		Snake River main stem:									
788	13-3343	Snake River near Anatone, Wash.	92,960	1958-64	1964	17.27	[6] 119,000	Dec. 25	17.47	[6] 121,000	2
		Asotin Creek basin:									
789	13-3347	Asotin Creek below Kearney Gulch, near Asotin, Wash.	170	1959-64	1963	3.75	420	Dec. 23	7.30	2,720	
				1904	1904	[1] 4.3	1,180				
		Critchfield Draw basin:									
790	13-3352	Critchfield Draw near Clarkston, Wash.	1.80	1959-64	1964	13.16	705	Dec. 22	11.79	196	
		Clearwater River basin:									
791	13-3365	Selway River near Lowell, Idaho	1,910	1929-64	1948	16.04	48,900	Dec. 23	8.44	14,200	<2
792	13-3369	Fish Creek near Lochsa ranger station, Idaho.	89.2	1957-64	1964	5.54	2,280	Dec. 23	5.02	1,810	
793	13-3370	Lochsa River near Lowell, Idaho	1,180	1910-12, 1929-64.	1964	13.50	35,100	Dec. 23	9.79	19,500	<2
794	13-3382	Sally Ann Creek near Stites, Idaho	15	1961-64	1964	9.99	305	Jan. 29	9.61	255	
795	13-3383	Cottonwood Creek near Fenn, Idaho	81.7					Jan. 29		1,740	
796	13-3385	South Fork Clearwater River at Stites, Idaho.	1,150	1910-12, 1964.	1912	[1] 6.00	10,700	Jan. 29	7.31	7,610	
				1964	1964	10.3	17,500				
797	13-3389.5	Lawyers Creek at Kamiah, Idaho	208					Jan. 29		2,460	
798	13-3390	Clearwater River at Kamiah, Idaho	4,850	1910-64	1964	19.16	103,000	Dec. 23	11.68	35,000	<2
799	13-3399	Deer Creek near Orofino, Idaho	6.8	1962-64	1962	8.87	220	Jan. 29	10.95	485	
800	13-3400	Clearwater River at Orofino, Idaho	5,580	1930-38, 1964.	1933	[1] 20.87	81,500	Dec. 24		[8] 38,000	
				1964	1964	20.32	99,700				
801	13-3405	North Fork Clearwater River at Bungalow ranger station, Idaho.	996	1944-64	1948	11.13	27,400	Dec. 23	10.13	24,700	10
802	13-3410	North Fork Clearwater River near Ahsahka, Idaho.	2,440	1926-64	1933	35.5	100,000	Dec. 23	29.14	67,900	[2] 1.03
803	13-3410.5	Clearwater River near Peck, Idaho	8,040	1964	1964	23.95	118,000	Dec. 23	22.0	102,000	

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		Upper Columbia River and Snake River basins—Continued									
		Clearwater River basin—Continued									
804	13-3411	Cold Springs Creek near Craigmont, Idaho.	8.07	1961–64	1963	7.40	190	Jan. 29	7.49	200	
805	13-3411.4	Big Canyon Creek at Peck, Idaho	225					Jan. 29		8,360	
806	13-3413	Bloom Creek near Bovill, Idaho	3.66	1959–64	1962	2.90	94	Dec. 23	3.17	151	
807	13-3414	East Fork Potlatch River near Bovill, Idaho.	42.5	1959–64	1962	5.45	964	Dec. 23	8.19	1,740	
808	13-3415	Potlatch River at Kendrick, Idaho	425	1946–64	1948	12.6	13,000	Jan. 29	13.7	16,000	[2] 1.03
809	13-3416	Arrow Gulch at Arrow, Idaho	2.80	1961–64	1963	10.48	150	Dec. 23 or 24	11.30	220	
810	13-3418	Lapwai Creek near Culdesac, Idaho	37.9					Jan. 29		2,190	
811	13-3424	Lapwai Creek near Lapwai, Idaho	235	1948	1948		3,800	Jan. 29		4,380	
812	13-3425	Clearwater River at Spalding, Idaho	9,570	1901–13,	1948		177,000	Dec. 23	18.95	122,000	5
				1924–64,	1963	[7] 27.77					
				1894.	1894	[1] 20.8	136,000				
		Dry Creek basin:									
813	13-3434.5	Dry Creek at mouth near Clarkston, Wash.	6.83	1963–64	1964	13.78	770	Dec. 22	12.6	463	
		Snake River main stem:									
814	13-3435	Snake River near Clarkston, Wash	103,200	1909–64	1948	40.36	[6] 369,000	Dec. 24	33.45	[6] 247,000	5
				1894	1894	[1] 24.7	409,000				
		Alpowa Creek basin:									
815	13-3435.2	Clayton Gulch near Alpowa, Wash	5.60	1961–64	1963	11.38	298	Dec. 22	7.83	142	
		Deadman Creek basin:									
816	13-3436.2	South Fork Deadman Creek tributary near Pataha, Wash.	.54	1961–64	1961	8.27	91	Dec. 22	6.54	43	
817	13-3436.6	Smith Gulch tributary near Pataha, Wash.	1.85	1955–64	1961	10.86	254	Jan. 30	8.47	145	
818	13-3436.8	Deadman Creek above Meadow Creek, at Central Ferry, Wash.	135	1963–64	1963	19.49	5,200	Dec. 22	10.89	1,740	[2] 2.10
819	13-3437	Ben Day Gulch tributary near Pomeroy, Wash.	.78	1961–64	1961	7.72	43	Dec. 22	5.93	7	
820	13-3438	Meadow Creek near Central Ferry, Wash.	66.2	1963–64	1963	7.33	2,230	Dec. 22	6.88	1,910	([3])
		Tucannon River basin:									
821	13-3443	Pataha Creek at Zumwalt, Wash	93.7	1949	1949		[1] 1,620	Dec. 22		1,360	

822	13-3443.5	Linville Gulch near Pomeroy, Wash.	5.6	1950	1950		[1] 9,750	Dec. 22		166	
823	13-3443.6	Skyhawk Canyon Creek near Pomeroy, Wash.	7.48	1950	1950		[1] 5,200	Dec. 22		261	
824	13-3445	Tucannon River near Starbuck, Wash.	431	1914-17, 1928-31, 1958-64.	1930	[1] 8.08	6,000	Dec. 22	9.84	7,980	([3])
825	13-3445.08	Kellogg Creek tributary near Starbuck, Wash.	6.0					Dec. 22	19.25	1,010	
826	13-3445.1	Kellogg Creek at Starbuck, Wash.	35.3	1963-64	1963	11.80	2,140	Dec. 22		4,000	([3])
		Palouse River basin:									
827	13-3447	Deep Creek tributary near Potlatch, Idaho.	2.90	1961-64	1961	12.44	72	Dec. 23	13.61	157	
828	13-3448	Deep Creek near Potlatch, Idaho	36.6	1961-64	1963	11.66	1,110	Dec. 23	13.96	1,700	
829	13-3461	Palouse River at Colfax, Wash.	497	1955-64	1963	[1] 9.10	8,030	Dec. 24	11.14	8,510	4
830	13-3480	South Fork Palouse River at Pullman, Wash.	132	1934-42, 1959-64.	1963	6.91	2,160	Dec. 23	7.11	2,610	19
				1948	1948	9.5	5,000				
831	13-3484	Missouri Flat Creek tributary near Pullman, Wash.	.88	1955-64	1963	[1] 12.78	234	Dec. 22	12.60	129	
832	13-3485	Missouri Flat Creek at Pullman, Wash.	27.1	1934-40, 1960-64.	1963	4.70	915	Dec. 23	5.24	1,080	[2] 1.11
				1948	1948	[1] 6.3	1,500				
833	13-3492	South Fork Palouse River at Colfax, Oreg.	277					Dec. 23		[8] 3,560	
834	13-3492.1	Palouse River below South Fork, at Colfax, Wash.	796	1963-64	1964	6.69	3,100	Jan. 29	14.53	11,600	
				1963	1963	16.49	14,500				
835	13-3493	Palouse River tributary at Colfax, Wash.	2.10	1955-64	1963	22.12	183	Dec. 22	18.64	55	
836	13-3493.1	Palouse River at Winona, Wash.	986					Jan. 29	11.52	9,900	
837	13-3493.2	Rebel Flat Creek at Winona, Wash.	75					Jan. 28	11.83	840	[2] 3.39
838	13-3493.5	Hardman Draw tributary at Plaza, Wash.	1.64	1955-64	1957	15.85	1,780	Jan. 29	8.62	92	
839	13-3494	Pine Creek at Pine City, Wash.	302	1961-64	1963	20.90	10,600	Dec. 23	14.00	4,260	19
840	13-3495	Rock Creek near Ewan, Wash.	523	1903-05, 1914-17, 1959, 1963-64.	1963		4,000	Jan. 30	5.70	2,930	3
841	13-3497	Cottonwood Creek near Ewan, Wash.	110					Jan. 28	9.89	1,190	[2] 1.03
842	13-3505	Union Flat Creek near Colfax, Wash.	189	1953-64	1963	10.58	2,260	Jan. 29	11.80	2,930	[2] 1.31
843	13-3510	Palouse River at Hooper, Wash.	2,500	1897-1916, 1951-64.	1963	19.13	33,500	Jan. 30	14.85	17,100	8
844	13-3525	Cow Creek at Hooper, Wash.	679	1951-53, 1962-64.	1963	7.15	1,150	Jan. 31	2.92	109	<2
845	13-3525.5	Stewart Canyon tributary near Riparia, Wash.	1.27	1959-64	1963	13.3	277	Dec. 22	12.84	172	
		Snake River main stem:									
846	13-3530	Snake River below Ice Harbor Dam, Wash.	108,500	1909-17, 1962-64,	1913	[1] 51.08	298,000	Dec. 24	[4] 354.07	[6] 265,000	5
				1948	1948	361.9					

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		Upper Columbia River and Snake River basins—Continued									
		Smith Canyon basin:									
847	13-3530.5	Smith Canyon tributary near Connell, Wash.	1.80	1955–64	1956	10.65	46	Jan. 30	9.28	24	
		Lower Columbia River basin									
		Walla Walla River basin:									
848	14-0100	South Fork Walla Walla River near Milton, Oreg.	63	1903, 1906–17, 1931–64.	1946	4.20	2,430	Jan. 29	5.60	2,530	23
				1931	1931	6					
849	14-0110	North Fork Walla Walla River near Milton, Oreg.	42	1930–64	1946	[1] 6.97	1,980	Jan. 30	8.05	2,050	35
850	14-0120	Walla Walla River at Milton, Oreg.	155				See sediment summary, table 20.				
851	14-0130	Mill Creek near Walla Walla, Wash	59.6	1913–17, 1938, 1939–64.	1945	17.85	2,610	Jan. 29	18.72	3,680	50
								Dec. 23	19.26		
852	14-0135	Blue Creek near Walla Walla, Wash	17.0	1939–64	1945	43.35	725	Jan. 28	43.63	716	26
853	14-0136	Mill Creek below Blue Creek, near Walla Walla, Wash.	91	1962–64	1964		[8] 703	Jan. 29		[8] 3,270	
854	14-0150	Mill Creek at Walla Walla, Wash	95.7	1941–64	1945	[1] 4.0	2,760	Dec. 23	5.14	2,400	
855	14-0160	Dry Creek near Walla Walla, Wash	48.4	1949–64	1949	12.5	3,340	Dec. 22	7.94	1,040	27
856	14-0160.5	Dry Creek at Lowden, Wash	246					Dec. 22	32.19	10,800	
857	14-0161	Pine Creek near Touchet, Wash	170					Dec. 22	16.5	3,770	
858	14-0165	East Fork Touchet River near Dayton, Wash.	102	1941–51, 1956–64.	1948	5.28	1,530	Dec. 23	6.15	5,450	[2] 1.48
859	14-0166	Hatley Creek near Dayton, Wash	4.12	1955–64	1963	16.58	244	Dec. 22	15.44	205	
860	14-0166.4	East Fork Touchet River at Dayton, Wash.	108				See sediment summary, table 20.				
861	14-0166.5	Davis Hollow near Dayton, Wash	3.01	1956–64	1956		305	Dec. 22	16.99	62	
862	14-0167.4	Mustard Hollow at Dayton, Wash	3.06	1956	1956		875	Dec. 22		165	
863	14-0168	Patit Creek near Dayton, Wash	53.5				See sediment summary, table 20.				
864	14-0169	Whiskey Creek near Dayton, Wash	16.4				See sediment summary, table 20.				
865	14-0169.5	Coppei Creek at Waitsburg, Wash	34.1				See sediment summary, table 20.				
866	14-0170	Touchet River at Bolles, Wash	361	1924–29, 1951–64.	1928	[1] 7.04	4,470	Dec. 23	14.06	9,350	[2] 1.27
867	14-0170.3	Whetstone Hollow near Dayton, Wash.	14.9	1949	1949		790	Dec. 22		271	[2] 1.61
868	14-0170.4	Thorn Hollow near Dayton, Wash	2.68	1962–64	1963	8.60	202	Dec. 22	8.85	218	

869	14-0170.7	East Fork McKay Creek near Huntsville, Wash.	4.92	1963-64	1963	16.17	733	Dec. 22	14.44	622	
870	14-0171.2	Touchet River at Lamar, Wash	520					Jan. 29	9.81	7,800	
871	14-0172	Badger Hollow near Clyde, Wash	4.16	1955-64	1963	10.53	362	Dec. 23	16.34	1,560	
872	14-0175	Touchet River near Touchet, Wash	731	1941-59	1949	14.7	13,300	Dec. 22	13.53	11,500	[2] 1.22
873	14-0176	Touchet River at Touchet, Wash	747	1941-64	1949	[1] 14.7	13,300	Dec. 22	18.19	11,500	
874	14-0185	Walla Walla River near Touchet, Wash.	1,657	1951-64	1952	12.10	16,300	Dec. 22	18.90	33,400	[2] 1.92
875	14-0191	Walla Walla River tributary near Wallula, Wash.	.80	1955-64	1958	15.45	6	Dec. 22	21.88	320	
		Columbia River main stem:									
876	14-0192	Columbia River below McNary Dam, near Umatilla, Oreg.	214,000	1950-64	1956	36.97	[6] 818,000	Dec. 24	24.50	[6] 352,000	
				1894	1894	44.2					
		Umatilla River basin:									
877	14-0194	Elbow Creek near Bingham Springs, Oreg.	.68					Jan. 30	13.16	103	
878	14-0200	Umatilla River above Meacham Creek, near Gibbon, Oreg.	125	1933-64	1946	8.84	4,320	Jan. 29	9.50	4,910	16
879	14-0203	Meacham Creek near Gibbon, Oreg	177				See sediment summary, table 20.				
880		Umatilla River at Cayuse, Oreg	394				See sediment summary, table 20.				
881	14-0208	Spring Creek at St. Andrews Mission, Oreg.	4.30	1958-64	1958	18.36	106	Jan. 30	19.71	170	
882	14-0210	Umatilla River at Pendleton, Oreg	637	1891-92, 1903-05, 1934-64.	1949	9.01	15,400	Jan. 30	9.40	15,500	45
				1882	1882		17,000				
883	14-0216	Umatilla River tributary near Pendleton, Oreg.	2.74	1958-64	1963	16.34	196	Jan. 30	19.22	278	
884	14-0225	McKay Creek near Pilot Rock, Oreg	180	1921, 1926-64.	1931	[1] 10.4	6,000	Jan. 30	8.40	7,400	[2] 1.58
885	14-0235	McKay Creek near Pendleton, Oreg	186	1918-23, 1924-64.	1921	[1] 4.4	3,250	Feb. 2	2.98	[6] 1,320	2
886	14-0250	Birch Creek at Rieth, Oreg	291	1921-23, 1927-64.	1950	[1] 7.2	1,860	Jan. 30	6.40	2,200	[2] 1.10
887	14-0260	Umatilla River at Yoakum, Oreg	1,280	1903-64	1906	[1] 15.0	20,000	Jan. 30	12.60	[6] 15,900	29
888	14-0320	Butter Creek near Pine City, Oerg	291	1928-64	1949	12.4	3,800	Jan. 30	10.37	2,740	[2] 2.10
889	14-0335	Umatilla River near Umatilla, Oreg	2,290	1903-64	1906	11.0	19,600	Jan. 30	10.75	19,800	[2] 1.29
		Four Mile Canyon basin:									
890	14-0341	Four Mile Canyon near Plymouth, Wash	81.2	1962-64				Jan. 28		559	
		Glade Creek basin:									
891	14-0342.5	Glade Creek tributary near Bickleton, Wash.	.5	1961-64	1963	4.65	43	Jan. 29	2.91	6.6	
892	14-0342.7	East Branch Glade Creek near Prosser, Wash.	50.3	1962-64	1963		5	Jan. 29	12.99	478	
893	14-0342.8	East Branch Glade Creek tributary near Prosser, Wash.	.96	1962-64				Jan. 29	7.0	300	
		Dead Canyon basin:									
894	14-0343.2	Dead Canyon triburaty near Alderdale, Wash.	.62	1955-64	1962	8.49	2	Dec. 22	10.13	17	

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		Lower Columbia River basin—Continued									
		Alder Creek basin:									
895	14-0343.25	Alder Creek near Bickleton, Wash	8.35	1963–64	1963	13.05	880	Dec. 22	13.42	973	
896	14-0343.5	Alder Creek at Alderdale, Wash	197	1962–64	1963	[1] 8.80	5,560	Dec. 22	13.3	17,600	([3])
		Willow Creek basin:									
897	14-0343.7	Willow Creek tributary near Heppner, Oreg.	1.4	1958–64	1963	12.55	11	Jan. 30	13.60	26	
898	14-0345	Willow Creek at Heppner, Oreg	87	1951–64	1957	6.15	812	Jan. 30	5.10	635	13
				1903	1903		36,000				
899	14-0348	Rhea Creek near Heppner, Oreg	120	1960–64	1963	6.72	1,200	Jan. 30	6.83	1,260	[2] 1.10
900	14-0360	Willow Creek near Arlington, Oreg	850	1906, 1960–64.	1906	[1] 7.8	2,100	Dec. 22	11.05	14,700	([3])
		China Creek basin:									
901		China Creek near Arlington, Oreg	48.6					Dec. 22		1,020	
		Rock Creek basin:									
902	14-0364.8	Rock Creek near Goldendale, Wash	67.6	1953, 1955–56, 1961, 1963.	1955'		2,870	Dec. 22		7,700	
903	14-0366	Rock Creek near Roosevelt, Wash	213	1962–64	1963	19.8	3,940	Dec. 22	21.2	14,200	([3])
		John Day River basin:									
904	14-0368	John Day River near Prairie City, Oreg	17.4					Dec. 22	9.08	145	<2
905	14-0375	Strawberry Creek above Slide Creek, near Prairie City, Oreg.	7.00	1930–64	1948		172	Dec. 23	1.67	48	<2
					1956	[7] 3.23					
906	14-0385	John Day River at Prairie City, Oreg	231	1925–64	1952	6.27	2,100	Dec. 22	6.00	2,400	[2] 1.39
907	14-0385.5	East Fork Canyon Creek near Canyon City, Oreg.	24.8					Dec. 21	[7] 13.46	285	3
908	14-0386	Vance Creek near Canyon City, Oreg	6.54	1963–64	1964	11.52	7.6	Dec. 21	13.00	39	
909	14-0387.5	Beech Creek near Fox, Oreg	1.94					Jan. 30	12.47	15	
910		South Fork John Day River at Dayville, Oreg.	600				See sediment summary, table 20.				
911	14-0405	John Day River at Picture Gorge, near Dayville, Oreg.	1,680	1926–64	1932	14.0	6,800	Dec. 22	14.97	8,170	[2] 1.40
912	14-0410	Desolation Creek near Dale, Oreg	108	1949–64	1958	5.43	1,240	Dec. 22	5.00	930	8
913	14-0419	Line Creek near Lehman Springs, Oreg	2.4					Jan. 30	14.44	90	
914	14-0420	Camas Creek near Lehman, Oreg	61	1950–64	1955	4.56	1,880	Jan. 30	5.08	1,760	[2] 1.21

915	14-0425	Camas Creek near Ukiah, Oreg.	121	1914-17, 1919-24, 1932-64.	1932		2,600	Jan. 30	5.21	3,840	[2] 1.54
					1963	[7] [21] 5.24					
916	14-0438	Bridge Creek near Prairie City, Oreg.	6.93	1963-64	1964	7.77	22	Jan. 30	8.59	45	
917	14-0438.5	Cottonwood Creek near Galena, Oreg.	3.89					Dec. 22	11.64	66	
918	14-0439	Granite Creek near Dale, Oreg.	1.90					Dec. 21	14.53	46	
919	14-0440	Middle Fork John Day River at Ritter, Oreg.	515	1929-64	1932		4,000	Jan. 30	8.39	4,730	[2] 1.20
					1963	[7] 9.13					
920	14-0460	North Fork John Day River at Monument, Oreg.	2,520	1925-64	1932	14.8	22,000	Jan. 30	18.45	33,400	[2] 1.73
921	14-0464	Donnely Creek tributary near Service Creek. Oreg,	1.85	1963-64	1964	9.42	3.6	Jan. 30	10.57	30	
922	14-0465	John Day River at Service Creek, Oreg	5,090	1925-26, 1929-64.	1932	[1] 16.75	28,900	Dec. 23	17.85	40,200	[2] 1.28
923	14-0469	John Day River tributary near Clarno, Oreg.	2.0	1959-64	1963	26.01	43	Dec. 21	27.13	83	
924	14-0473	Condon Canyon tributary near Condon, Oreg.	1.03	1963-64	1964			Dec. 21		104	
925	14-0473.5	Rock Creek tributary near Hardman, Oreg.						Jan. 30	14.62	117	
926	14-0480	John Day River at McDonald Ferry, Oreg.	7,580	1904-64	1907		27,800	Dec. 24	13.59	42,800	[2] 1.53
					1950	[7] 13.2					
				1894	1894	12.8	39,100				
927	14-0480.2	Grass Valley Canyon near Grass Valley, Oreg.	8.3	1958-64	1963	18.83	588	Dec. 21	21.77	1,570	
928	14-0480.4	Gordon Hollow at DeMoss Springs, Oreg.	8.86	1959-64	1961	12.48	720	Dec. 21	20.65	984	
929	14-0480.8	Buck Canyon near Klondike, Oreg	3.42	1959-64	1961	11.85	171	Dec. 21		904	
				1953	1953		1,030				
930		Grass Valley Creek near McDonald Ferry, Oreg.	210					Dec. 22		16,500	
		Spanish Hollow basin:									
931	14-0483	Spanish Hollow at Wasco, Oreg.	8.05	1959-64	1961	6.74	279	Dec. 21	10.52	585	
932		Spanish Hollow at Biggs, Oreg.	52.4				See sediment summary, table 20.				
		Columbia River main stem:									
933		Columbia River at Biggs, Oreg.	226,000				See sediment summary, table 20.				
		Fulton Canyon basin:									
934	14-0483.5	Fulton Canyon tributary near Wasco, Oreg.	6.75	1959-64	1961	13.14	335	Dec. 21	21.20	1,370	
		Deschutes River basin:									
935	14-0500	Deschutes River below Snow Creek, near La Pine, Oreg.	[19] 132	1937-64	1956		444	Dec. 24		[8] 270	
					1943	[7] 4.12					

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		Lower Columbia River basin—Continued									
		Deschutes River basin—Continued									
936	14-0505	Cultus River above Cultus Creek, near La Pine, Oreg.	[19] 16.5	1922-25, 1937-64.	1956		178	Dec. 24		[8] 74	
					1952	[7] 1.23					
937	14-0510	Cultus Creek above Crane Prairie Reservoir, near La Pine, Oreg.	[19] 33.2	1924, 1937-64.	1958		219	Dec. 25	4.15	336	[2] 2.45
					1962	[7] 3.05					
938	14-0520	Deer Creek above Crane Prairie Reservoir, near La Pine, Oreg.	[19] 21.5	1924, 1937-64.	1942		97	Dec. 25	(3)	200	[2] 2.70
					1956	[7] 3.14					
939	14-0525	Quinn River near La Pine, Oreg.		1922-25, 1937-64.	1949		59	Jan. 26-31		[8] 34	
					1943	[7] 3.92					
940	14-0540	Deschutes River below Crane Prairie Reservoir, near La Pine, Oreg.	[19] 254	1913-17, 1922-64.	1947	3.34	[6] 1,170	Jan. 11		[6, 8] 194	
941	14-0545	Brown Creek near La Pine, Oreg.	[19] 19.7	1922-25, 1938-64.	1956	1.64	104	Jan. 29-31		[8] 44	
942	14-0555	Odell Creek near Crescent, Oreg.	39.0	1912-14, 1923-24, 1933-64.	1953		416	Dec. 25	2.60	1,100	[2] 2.63
					1947	[7] 2.03					
943	14-0565	Deschutes River below Wickiup Reservoir, near La Pine, Oreg.	[19] 483	1938-64.	1956, 1962		[6] 2,280	Dec. 23-27		[6, 8] 30	
944	14-0575	Fall River near La Pine, Oreg.	[19] 45.1	1938-64.	1952	1.94	250	Jan. 28-31		[8] 151	
945	14-0600	Crescent Creek at Crescent Lake, near Crescent, Oreg.	[19] 60.7	1912-15, 1927-64.	1929, 1936		[6] 313	Dec. 1-7		[6, 8] 17	
946	14-0630	Little Deschutes River near La Pine, Oreg.	[19] 859	1910-13, 1918, 1920, 1924-64.	1950, 1956	7.25	[6] 1,320	Dec. 25	8.18	[6] 3,660	
947	14-0645	Deschutes River at Benham Falls, near Bend, Oreg.	1,759	1906-14, 1920-21, 1924-64.	1909		5,000	Dec. 26	7.72	[6] 3,470	
948	14-0660	Deschutes River below Lava Island, near Bend, Oreg.	1,829	1926-64.	1956	4.78	[6] 2,940	Dec. 26	5.14	[6] 3,360	
949	14-0705	Deschutes River below Bend, Oreg.	1,899	1914-64.	1918, 1921	3.9	2,500	Dec. 27	4.90	[6] 2,820	
950	14-0730	Tumalo Creek near Bend, Oreg.	47.3	1913-64.	1923		1,000	Dec. 23	3.45	780	26
951	14-0750	Squaw Creek near Sisters, Oreg.	54.8	1906-64.	1909	[1] 8.75	(3)	Dec. 23	6.59	1,980	[2] 2.26
					1941	3.33	1,130				
952	14-0765	Deschutes River near Culver, Oreg.	2,705	1952-64.	1955	[1] 5.18	3,040	Dec. 24	10.00	6,680	
953	14-0778	East Fork Wolf Creek near Paulina, Oreg.	2.02					Dec. 22	12.62	268	

954	14-0780	Beaver Creek near Paulina, Oreg.	450	1942-64	1945	10.2	3,620	Dec. 22	14.20	12,800	[2] 4.10
955	14-0782	South Fork Crooked River tributary near Hampton, Oreg.	19.6					Dec. 21	16.20	177	[2] 1.32
956	14-0798	Crooked River above Prineville Reservoir, near Post, Oreg.	[19] 2,400	1960-64	1963	9.65	5,020	Dec. 23	15.00	19,700	[2] 1.93
957	14-0804	Prineville Reservoir near Prineville, Oreg.	2,700	1960-64	1962	[4] 3,235.80	[5] 155,900	Dec. 27	[4] 3,238.95	[5] 165,800	
958	14-0805	Crooked River near Prineville, Oreg.	2,700	1908-14, 1941-64.	1952	[1] 8.2	8,410	Dec. 30	7.77	[6] 3,300	<2
959		McKay Creek near Prineville, Oreg.	75.7					Dec. 23		3,950	
960	14-0874	Crooked River below Opal Springs, near Culver, Oreg.	4,300	1961-64	1963	5.41	[6] 3,280	Dec. 24	9.36	[6] 6,660	[2] .73
961	14-0880	Lake Creek near Sisters, Oreg.	22.2	1911-13, 1915-64.	1955	3.65	380	Dec. 23		[8] 500	
962	14-0915	Metolius River near Grandview, Oreg.	[19] 316	1912-13, 1921-64.	1923	[1] 3.32	5,780	Dec. 24	6.81	7,530	[2] 1.32
963	14-0921	Lake Billy Chinook near Metolius, Oreg.	7,490	1964	1964	[4] 1,913.3	[11] 417,900	Dec. 28	[4] 1,945.0	[11] 534,700	
964	14-0923	Willow Creek tributary near Culver, Oreg.	7.47					Dec. 22	13.62	89	
965	14-0925	Deschutes River near Madras, Oreg.	7,820	1923-64	1943	[1] 6.89	13,300	Dec. 28	6.29	[6] 15,800	[2] .92
966	14-0937	Trout Creek tributary at Ashwood, Oreg.	1.9	1959-64	1961	5.99	25	Dec. 21	6.61	44	
967	14-0942	Antelope Creek at Antelope, Oreg.	26	1959-64	1963	12.90	136	Dec. 21	20.61	977	([3])
968		Antelope Creek near Willowdale, Oreg.	95					Dec. 22		4,760	
969	14-0943	Cow Canyon Creek near Antelope, Oreg.	2.9	1959-64	1961	29.16	80	Dec. 21	32.88	142	
970	14-0952	Sagebrush Creek tributary near Gateway, Oreg.	7.4	1957-64	1957		5,200	Dec. 21	13.03	108	
971	14-1008	Jordan Creek near Tygh Valley, Oreg.	9.01					Dec. 22	18.56	675	
972	14-1015	White River below Tygh Valley, Oreg.	368	1917-64	1923	[1] 13.3	13,300	Dec. 23	11.80	11,300	[2] 1.18
973	14-1030	Deschutes River at Moody, near Biggs, Oreg.	10,500	1897-99, 1906-64.	1923	[1] 10.2	43,600	Dec. 22	11.80	[6] 75,500	[2] 1.68
		Fifteenmile Creek basin:									
974	14-1041	Ramsey Creek near Dufur, Oreg.	3.87					Dec. 22	13.86	124	
		Columbia River main stem:									
975	14-1057	Columbia River at The Dalles, Oreg	237,000	1858-1964.	1894	[1] 59.6	1,240,000	Dec. 25		364,000	
		Mill Creek basin:									
976	14-1058.5	South Fork Mill Creek near The Dalles, Oreg.	28.0	1959-64	1961	4.69	436	Dec. 22	5.22	1,220	[2] 2.33
		Klickitat River basin:									
977	14-1118	West Prong Little Klickitat River near Goldendale, Wash.	10.4	1961-64	1961	11.69	192	Dec. 22	16.16	569	22
978	14-1120	Little Klickitat River near Goldendale, Wash.	83.5	1910-12, 1946-51, 1957-64.	1961	7.71	2,830	Dec. 22	15.0	5,200	[2] 1.30

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Maximum flood previously known: Year	Maximum flood previously known: Gage height (ft)	Maximum flood previously known: Discharge (cfs)	Maximum December 1964 and January 1965: Day	Maximum December 1964 and January 1965: Gage height (ft)	Maximum December 1964 and January 1965: Discharge: Cfs	Maximum December 1964 and January 1965: Discharge: Recurrence interval (yr)
		Lower Columbia River basin—Continued									
		Klickitat River basin—Continued									
979	14-1122	Little Klickitat River tributary near Goldendale, Wash.	0.71	1960–64	1963	11.0	192	Dec. 23	11.14	229	......
980	14-1123	Spring Creek near Blockhouse, Wash.	2.75	1964	......	......	......	Dec. 22	3.44	271	......
981	14-1124	Mill Creek near Blockhouse, Wash.	26.9	1964	......	......	......	Dec. 23	4.65	290	<2
982	14-1124.9	Bowman Creek near Wahkiacus, Wash.	60.0	1961	1961	......	959	Dec. 22	......	1,060	4
983	14-1125	Little Klickitat River near Wahkiacus, Wash.	280	1944–64	1948	9.40	7,000	Dec. 23	11.65	17,300	[2] 2.34
984	14-1130	Klickitat River near Pitt, Wash.	1,297	1909–12, 1928–64.	1933	[1] 12.50	25,500	Dec. 23	14.34	31,100	[2] 1.02
		Mosier Creek basin:									
985	14-1132	Mosier Creek near Mosier, Oreg.	41.5	1963–64	1964	[7] 5.34	580	Dec. 23	8.9	4,790	[2] 5.18
		Hood River basin:									
986	14-1134	Dog River near Parkdale, Oreg.	4.50	1959–64	1962	......	34	Dec. 23	......	56	<2
					1963	[7] 3.59	......	Dec. 22	[7] 3.92	......	......
987	14-1185	West Fork Hood River near Dee, Oreg.	96	1913–16–1932–64.	1933	12.4	12,900	Dec. 22	27.0	[8] 15,000	......
988	14-1200	Hood River at Tucker Bridge, near Hood River, Oreg.	279	1897–99, 1913–14, 1915–17.	1899	[1] 13.0	15,200	Dec. 22	20.6	33,200	40
		White Salmon River basin:									
989	14-1213	White Salmon River below Cascades Creek, near Trout Lake, Wash.	32.4	1957–64	1962	3.62	738	Dec. 23	3.86	834	2
990	14-1214	White Salmon River above Trout Lake Creek, near Trout Lake, Wash.	64.9	1959–64	1962	3.98	970	Dec. 23	4.16	1,080	<2
991	14-1220	White Salmon River near Trout Lake, Wash.	185	1918, 1928–31, 1957–64.	1962	8.90	3,860	Dec. 23	8.69	3,670	4
992	14-1229	White Salmon River at BZ Corner, Wash.	269	1958–64	1962	5.52	3,830	Dec. 23	5.40	3,570	2
993	14-1235	White Salmon River near Underwood, Wash.	386	1912–13, 1915–30, 1935–64.	1917	[1] 9.5	9,700	Dec. 23	9.74	9,640	37
		Little White Salmon River basin:									
994	14-1252	Rock Creek near Willard, Wash.	4.10	1949–64	1949	13.16	428	Dec. 22	13.87	491	[2] 1.31
995	14-1255	Little White Salmon River near Cook, Wash.	134	1956–64	1960	7.51	5,210	Dec. 23	8.94	9,560	12

		Unnamed tributary to Columbia River:									
996	14-1263	Columbia River tributary at Home Valley, Wash.	.54	1950-64	1955	22.58	75	Dec. 23	24.68	103	[2] 1.12
		Wind River basin:									
997	14-1270	Wind River above Trout Creek, near Carson, Wash.	108	1944-64	1945	15.5	8,880	Dec. 22	15.12	8,160	12
998	14-1285	Wind River near Carson, Wash	225	1934-64	1960	18.78	26,400	Dec. 23	19.26	28,300	[2] 1.24
		Sandy River basin:									
999	14-1340	Salmon River near Government Camp, Oreg.	8.7	1910-12, 1926-64.	1956	3.95	682	Dec. 23	4.75	1,300	[2] 1.17
1000	14-1370	Sandy River near Marmot, Oreg	262	1911-64	1923	[1] 17.5	29,200	Dec. 22	17.05	61,400	[2] 1.78
1001	14-1388	Blazed Alder Creek near Rhododendron, Oreg.	8.17	1963-64	1963	5.54	1,300	Dec. 22	8.25	2,610	[2] 1.09
1002	14-1390	Lake Ben Morrow near Bull Run, Oreg.	74.6	1928-64	1931	[4] 1,047.40	[11] 31,600	Dec. 22	[4] 1,046.30	[11] 31,130	....
1003	14-1397	Cedar Creek near Brightwood, Oreg	7.93	1964	1964	2.48	109	Dec. 22	7.20	1,990	6
1004	14-1399	Bull Run Reservoir No. 2 near Bull Run, Oreg.	102	1962-64	1962	[4] 863.60	[11] 22,580	Dec. 22	[4] 866.00	[11] 23,660	....
1005	14-1400	Bull Run River near Bull Run, Oreg	107	1907-64	1931	[1] 13.8	20,600	Dec. 22	[12] 17.21	[6] 25,100	[2] 1.40
1006	14-1415	Little Sandy River near Bull Run, Oreg.	22.3	1911-13, 1919-64.	1921	9.18	5,320	Dec. 22	9.01	5,020	[2] 1.34
1007	14-1425	Sandy River below Bull Run River, near Bull Run, Oreg.	440	1910-14, 1929-64.	1931	20.6	58,000	Dec. 22	22.3	84,400	[2] 1.42
		Columbia River main stem:									
1008	14-1447	Columbia River at Vancouver, Wash	241,000	1963-64	1964	25.44	[6] 686,000	Dec. 25	[4 7 21] 29.42	[6] 550,000	....
				1897	1897	[4] 36.2	....	....	....	....	....

Willamette River basin

		Willamette River basin:									
1009	14-1447.75	Noisy Creek near McCredie Springs, Oreg.	5.20	....	....	....	....	Dec. 21	27.08	940	[2] 1.62
1010	14-1448	Middle Fork Willamette River near Oakridge, Oreg.	258	1958-64	1960	9.55	10,200	Dec. 22	16.96	39,800	[2] 2.33
1011	14-1448.7	Middle Fork Willamette River tributary near Oakridge, Oreg.	.50	1960-64	1964	16.89	53	Dec. 22	17.94	82	[2] 2.10
1012	14-1449	Hills Creek above Hills Creek Reservoir, near Oakridge, Oreg.	52.7	1958-64	1961	7.24	2,410	Dec. 22	12.23	10,700	[2] 2.54
1013	14-1451	Hills Creek Reservoir near Oakridge, Oreg.	389	1961-64	1962	[4] 1,542.11	[11] 353,600	Dec. 25	[4] 1,541.92	[11] 353,100	....
1014	14-1455	Middle Fork Willamette River above Salt Creek, near Oakridge, Oreg.	392	1913-14, 1935-64.	1945	[1] 12.06	34,000	Dec. 27	9.49	[6] 11,800	....
1015	14-1456.9	Swamp Creek near McCredie Springs, Oreg.	1.51	....	....	....	....	Dec. 22	12.39	120	17
1016	14-1464	Mule Creek near McCredie Springs, Oreg.	1.48	....	....	....	....	Dec. 22	12.52	195	[2] 1.37
1017	14-1465	Salmon Creek near Oakridge, Oreg.	117	1913-19, 1933-64.	1956	[1] 11.18	10,400	Dec. 22	9.15	11,600	[2] 1.38

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yl)
		Willamette River basin—Continued									
		Willamette River basin—Continued									
1018	14-1474	Tumble Creek near Westfir, Oreg.	1.52					Dec. 22	9.82	98	2
1019	14-1475	North Fork of Middle Fork Willamette River near Oakridge, Oreg.	246	1909-16, 1935-64.	1945	16.6	17,000	Dec. 22	19.14	24,400	[2] 1.33
1020	14-1480	Middle Fork Willamette River below North Fork, near Oakridge, Oreg.	924	1911-12, 1923-64.	1945	[1] 18.8	81,800	Dec. 22	11.75	[6] 55,800	[2] 1.25
1021	14-1487	Fern Creek near Lowell, Oreg.	.44	1953-64	1961	6.04	52	Dec. 21	5.67	35	
1022	14-1490	Lookout Point Reservoir near Lowell, Oreg.	991	1953-64	1963	[4] 929.33	[11] 457,400	Dec. 26	[4] 931.09	[11] 465,100	
1023	14-1500	Middle Fork Willamette River near Dexter, Oreg.	1,001	1946-64	1953	[1] 12.46	62,600	Dec. 26	11.06	[6] 29,500	
1024	14-1503	Fall Creek near Lowell, Oreg.	118	1963-64	1964	8.57	7,300	Dec. 22	11.39	11,200	4
1025	14-1508	Winberry Creek near Lowell, Oreg.	43.9	1963-64	1964	6.17	2,740	Dec. 22	8.07	4,500	8
1026	14-1510	Fall Creek below Winberry Creek, near Fall Creek, Oreg.	186	1935-64	1956	18.80	24,700	Dec. 22	15.53	16,600	5
1027	14-1520	Middle Fork Willamette River at Jasper, Oreg.	1,340	1905-12, 1913-17, 1952-64.	1909	[1] 17.4	94,000	Dec. 26	13.43	[6] 43,500	
1028	14-1525	Coast Fork Willamette River at London, Oreg.	72.1	1935-64	1945	13.25	8,800	Dec. 22	13.37	12,500	[2] 1.16
1029	14-1530	Cottage Grove Reservoir near Cottage Grove, Oreg.	104	1942-64	1961	[4] 792.69	[11] 34,910	Dec. 24	[4] 794.23	[11] 36,760	
1030	14-1535	Coast Fork Willamette River below Cottage Grove Dam, Oreg.	104	1939-64	1949	9.75	[6] 3,460	Dec. 24	11.83	[6] 5,910	
1031	14-1545	Row River above Pitcher Creek, near Dorena, Oreg.	211	1935-64	1945	14.33	19,600	Dec. 22	18.19	33,100	[2] 1.14
1032	14-1550	Dorena Reservoir near Cottage Grove, Oreg.	265	1949-64	1963	[4] 839.14	[11] 85,580	Dec. 23	[4] 844.03	[11] 95,540	
1033	14-1555	Row River near Cottage Grove, Oreg.	270	1939-64	1945	18.20	21,400	Dec. 23	15.98	[6] 17,200	
1034	14-1565	Mosby Creek at mouth, near Cottage Grove, Oreg.	95.3	1946-64	1964	11.31	7,510	Dec. 22	13.37	14,100	[2] 1.22
1035	14-1575	Coast Fork Willamette River near Goshen, Oreg.	642	1905-12, 1950-64.	1909	[1] 19.5	58,500	Dec. 24	17.11	[6] 32,100	
1036	14-1582.5	Hackleman Creek near Upper Soda, Oreg.	.21	1953-64	1956	[7] 5.38	102	Dec. 21	5.20	95	
1037	14-1585	McKenzie River at outlet of Clear Lake, Oreg.	[19] 92.4	1912-15, 1947-64.	1955	7.66	2,970	Dec. 23	8.15	3,300	18

1038	14-1587.9	Smith River above Smith River Reservoir, near Belknap Springs, Oreg.	16.2	1960-64	1960	6.38	1,720	Dec. 22	11.9	5,160	[2] 1.29
1039	14-1588.5	McKenzie River below Trail Bridge Dam, near Belknap Springs, Oreg.	184	1959-64	1963	[1] 4.62	[6] 6,450	Dec. 22	12.45	[6] 11,200	20
1040	14-1589.5	Twisty Creek near Belknap Springs, Oreg.	1.18					Dec. 22	26.94	212	[2] 1.69
1041	14-1590	McKenzie River at McKenzie Bridge, Oreg.	348	1910-64	1923	[1] 8.3	16,500	Dec. 22	10.36	19,100	[2] 1.06
1042	14-1591	Horse Creek near McKenzie Bridge, Oreg.	149	1962-64	1962	[7] 4.33	1,770	Dec. 22		8,580	[2] 1.71
				1945	1945	7.25	7,500	Dec. 24	[7] 8.30		
1043	14-1592	South Fork McKenzie River above Cougar Reservoir, near Rainbow, Oreg.	160	1957-64	1960	11.83	8,660	Dec. 22	20.06	18,400	44
				1956	1956	15	(3)				
1044	14-1594	Cougar Reservoir near Rainbow, Oreg	207	1963-64	1964	[4] 1,690.42	[11] 208,500	Dec. 27	[4] 1,692.44	[11] 211,000	
1045	14-1595	South Fork McKenzie River near Rainbow, Oreg.	208	1947-64	1956		17,600	Jan. 8	5.31	[6] 6,220	
					1955	[7] 8.90					
				1945	1945	9.3	24,500				
1046		Tidbits Creek near Blue River, Oreg	9.80					Dec. 22		4,710	[2] 2.17
1047	14-1611	Blue River below Tidbits Creek, near Blue River, Oreg.	45.8	1963-64	1963	7.76	3,190	Dec. 22	15.32	12,400	[2] 1.24
1048	14-1615	Lookout Creek near Blue River, Oreg	24.1	1949-55, 1963-64.	1953	7.18	3,620	Dec. 22	8.88	6,660	[2] 1.27
1049	14-1616	Lookout Creek tributary near Blue River, Oreg.	.37	1954-64	1956	3.35	75	Dec. 21	3.34	65	
1050	14-1620	Blue River near Blue River, Oreg	75.0	1935-64	1945	9.80	13,300	Dec. 22	12.3	19,600	[2] 1.26
1051	14-1625	McKenzie River near Vida, Oreg	930	1910-11, 1924-64.	1945	17.70	64,400	Dec. 22	16.43	[6] 57,400	20
				1923	1923	17.2	62,000				
1052	14-1630	Gate Creek at Vida, Oreg	47.6	1952-64	1956	9.63	6,070	Dec. 22	12.18	7,140	[2] 1.01
1053	14-1650	Mohawk River near Springfield, Oreg	177	1935-52, 1963-64.	1964	20.2	10,500	Dec. 22	22.60	13,000	15
				1955	1955	[7] 22.9	9,200				
1054	14-1655	McKenzie River near Coburg, Oreg	1,337	1944-64	1945	17.36	88,200	Dec. 23	16.10	[6] 87,300	27
				1861	1861	18.2	(3)				
1055	14-1660	Willamette River at Harrisburg, Oreg	3,420	1944-64	1945	19.69	210,000	Dec. 23	17.25	[6] 125,000	
				1861	1861	20.5					
1056	14-1665	Long Tom River near Noti, Oreg	89.3	1935-64	1955	20.17	6,990	Dec. 22	19.65	6,450	9
1057	14-1670	Coyote Creek near Crow, Oreg	95.1	1940-64	1961	14.43	10.600	Dec. 22	13.95	8,720	[2] 1.04
1058	14-1680	Fern Ridge Reservoir near Elmira, Oreg	252	1941-64	1955	[4] 375.83	[5] 124,500	Dec. 27, 28	[4] 375.39	[5] 119,900	
1059	14-1690	Long Tom River near Alvadore, Oreg	252	1939-64	1943	[1] 15.12	11,500	Dec. 29		[6] 7,550	
1060	14-1693	Amazon Creek at Eugene, Oreg	3.35	1962-64	1964	7.29	527	Dec. 26	6.05	291	[2] 1.05
1061	14-1695	Amazon Creek near Eugene, Oreg	21.3	1954-64	1961	9.58	3,070	Dec. 22	8.95	2,040	[2] 1.44
1062	14-1697	Bear Creek near Cheshire, Oreg	5.19	1957-64	1964	21.66	426	Dec. 21	21.76	436	23
				1955	1955	[7] 27.3	(3)				
1063	14-1700	Long Tom River at Monroe, Oreg	391	1920-64	1943	[1] 17.14	19,300	Dec. 26	10.06	[6] 9,520	
1064	14-1710	Marys River near Philomath, Oreg	159	1940-64	1955	20.83	12,000	Dec. 22	20.72	13,600	27
1065	14-1715	Muddy Creek near Corvallis, Oreg	107	1920-23, 1925-27, 1963-64.	1923	[1] 17.53	3,500	Dec. 22	22.61	6,040	45

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Maximum flood previously known: Year	Maximum flood previously known: Gage height (ft)	Maximum flood previously known: Discharge (cfs)	Maximum December 1964 and January 1965: Day	Maximum December 1964 and January 1965: Gage height (ft)	Maximum December 1964 and January 1965: Discharge: Cfs	Maximum December 1964 and January 1965: Discharge: Recurrence interval (yr)
		Williamette River basin—Continued									
		Willamette River basin—Continued									
1066	14-1720	Calapooia River at Holley, Oreg	105	1935-64	1945	14.1	12,200	Dec. 22	[21] 15.30	12,600	27
1067	14-1723	Butte Creek near Plainview, Oreg	5.06	1955-64	1960	20.32	647	Dec. 21	19.03	472	<2
1068	14-1735	Calapooia River at Albany, Oreg	372	1940-64	1955		32,700	Dec. 23		28,400	[2] 1.04
					1943	[7] 25.5		Dec. 24	[7] 23.38		
1069	14-1740	Willamette River at Albany, Oreg	4,840	1878-82, 1892-64.	1881	37.8	266,000	Dec. 24	33.93	[6] 186,000	
				1861	1861	41.0	340,000				
1070	14-1741	Cox Creek at Albany, Oreg	15.2	1953-64	1960	12.81	985	Dec. 21	12.98	1,070	50
1071	14-1780	North Santiam River below Boulder Creek, near Detroit, Oreg.	216	1907-09, 1928-64.	1945	[1] 11.24	20,300	Dec. 22	[7] 13.76	26,700	[2] 1.26
1072	14-1786	Short Creek at Breitenbush Hot Springs, Oreg.	2.00					Dec. 21	15.11	206	4
1073	14-1788	Wind Creek near Detroit, Oreg	1.03	1954-64	1962	14.38	182	Dec. 21	16.20	231	22
1074	14-1790	Breitenbush River above Canyon Creek, near Detroit, Oreg.	106	1932-64	1962	12.72	12,900	Dec. 22	14.55	16,900	[2] 1.20
1075	14-1805	Detroit Reservoir near Detroit, Oreg	437	1953-64	1960	[4] 1,569.74	[11] 457,500	Dec. 26	[4] 1,569.25	[11] 455,800	
1076	14-1815	North Santiam River at Niagara, Oreg	453	1908-22, 1938-64.	1909	[1] 16.4	63,200	Dec. 26	10.19	[6] 19,300	
1077	14-1817	North Santiam River tributary near Gates, Oreg.	1.97	1952-64	1960	18.00	103	Jan. 30	19.00	132	
1078	14-1825	Little North Santiam River near Mehama, Oreg.	110	1931-64	1945	15.20	27,000	Dec. 22	16.73	36,000	[2] 1.22
1079	14-1830	North Santiam River at Mehama, Oreg	665	1905-07, 1910-14, 1921-64.	1945	15.37	76,600	Dec. 22	13.55	[6] 58,400	
					1921, 1923	[1] 17.5					
1080	14-1849	Sheek Creek near Cascadia, Oreg	.94	1953-64	1957	17.08	108	Dec. 22	18.20	116	4
1081	14-1850	South Santiam River below Cascadia, Oreg.	174	1935-64	1956	19.35	26,900	Dec. 22	19.68	27,600	22
1082	14-1858	Middle Santiam River near Cascadia, Oreg.	104	1963-64	1963	9.13	7,360	Dec. 22	15.75	22,900	50
1083	14-1859	Quartzville Creek near Cascadia, Oreg	99.2	1963-64	1963	12.46	10,800	Dec. 22	(3)	36,500	[2] 1.67
1084	14-1865	Middle Santiam River at mouth, near Foster, Oreg.	287	1950-64	1956	20.25	41,000	Dec. 22	25.80	67,800	[2] 1.14
1085	14-1870	Wiley Creek near Foster, Oreg	52.3	1947-64	1961		6,860	Dec. 22		8,370	[2] 1.02
					1955	[7] 8.42		Dec. 21	[7] 9.80		

1086	14-1875	South Santiam River at Waterloo, Oreg..	640	1905–07, 1910–11, 1923–64.	1945	22.85	74,200	Dec. 22	24.50	95,200	40
1087	14-1887	Crabtree Creek near Crabtree, Oreg......	111	1963–64......	1963	9.61	4,800	Jan. 28	14.01	8,410	....
1088	14-1888	Thomas Creek near Scio, Oreg.............	109	1962–64......	1964	11.57	7,080	Dec. 22	18.44	16,700	[2] 1.06
1089	14-1890	Santiam River at Jefferson, Oreg...........	1,790	1905–06, 1907–16, 1939–64.	1909	23.0	161,000	Dec. 22	24.22	[6] 197,000	[2] 1.05
				1921........	1921	24.4	202,000	....	....	....	....
				1861........	1861	25.0	....	....	....	....	....
1090	14-1895	Luckiamute River near Hoskins, Oreg....	34.3	1934–64......	1946, 1949	13.22	5,560	Dec. 22	12.70	5,390	10
1091	14-1900	Luckiamute River at Pedee, Oreg.........	115	1940–64......	1949	18.46	13,500	Dec. 22	20.09	15,700	50
1092	14-1901	Little Luckiamute River at Falls City, Oreg.	22.7	....	....	....	....	Dec. 22	7.70	3,570	[2] 1.02
1093	14-1902	Waymire Creek near Falls City, Oreg......	3.46	1954–65......	1955	16.33	522	Dec. 21	16.66	598	[2] 1.38
1094	14-1905	Luckiamute River near Suver, Oreg........	240	1905–11, 1940–64.	1949	33.10	23,800	Dec. 22	34.52	32,900	[2] 1.11
				1937........	1937	33.5	25,000	....	....	....	....
1095	14-1906	Soap Creek tributary near Suver, Oreg...	.57	1953–64......	1955	4.53	80	Jan. 28	4.62	84	[2] 1.05
1096	14-1907	Rickreall Creek near Dallas, Oreg........	27.4	1957–64......	1960	7.05	4,610	Dec. 22	8.78	7,160	[2] 1.49
1097	14-1910	Willamette River at Salem, Oreg..........	7,280	1909–16, 1923–64.	1923	38.3	348,000	Dec. 23	37.78	[6] 308,000	....
				1861........	1861	47	500,000	....	....	....	....
1098	14-1920	Mill Creek at Salem, Oreg...............	110	1934, 1938–64.	1960	7.75	[6] 1,670	Dec. 23	8.36	[6] 1,870	....
1099	14-1921	Glenn Creek near Salem, Oreg............	2.72	1952–64......	1955	[1,7] 14.26	172	Dec. 22	18.18	155	[2] 1.94
1100	14-1925	South Yamhill River near Willamina, Oreg.	133	1934–64......	1949	14.80	15,200	Dec. 22	17.07	19,600	[2] 1.22
1101	14-1928	South Yamhill River tributary near Willamina, Oreg.	1.81	1954–64......	1955	21.00	420	Dec. 22	14.25	262	[2] 1.21
1102	14-1930	Willamina Creek near Willamina, Oreg..	64.7	1934–64......	1955	11.65	7,760	Dec. 22	13.54	10,800	[2] 1.69
				1931........	1931	12	8,200	....	....	....	....
1103	14-1933	Mill Creek near Willamina, Oreg....	27.4	1958–64......	1960	9.38	4,160	Dec. 22	11.47	6,170	[2] 1.23
1104	14-1940	South Yamhill River near Whiteson, Oreg.	502	1940–64......	1955,	45.25	36,800	Dec. 23	47.20	47,200	[2] 1.22
				1937........	1937	46.9	....	....	....	....	....
1105	14-1943	North Yamhill River near Fairdale, Oreg.	9.03	1958–64......	1964	6.03	1,360	Dec. 22	....	2,330	[2] 1.96
								Dec. 23	[7] 9.70	....	....
1106	14-1960	Haskins Creek below reservoir, near McMinnville, Oreg.	6.90	1951–64......	1956	6.05	1,410	Dec. 22	5.98	1,030	....
1107	14-1970	North Yamhill River at Pike, Oreg........	66.8	1948–64......	1955	12.42	9,530	Dec. 22	12.03	8,940	[2] 1.19
1108	14-1973	Panther Creek near Carlton, Oreg....	3.19	1953–64......	1955	14.72	492	Dec. 21	15.03	612	[2] 1.56
1109	14-1980	Willamette River at Wilsonville, Oreg....	3,400	1948–64......	1953	[4] 87	248,000	Dec. 25	[4] 94.74	[6] 339,000	....
				1861........	1861	[4] 105	....	....	....	....	....
1110	14-1985	Molalla River above Pine Creek, near Wilhoit, Oreg.	97.0	1935–64......	1960	14.85	17,700	Dec. 22	16.3	24,300	[2] 1.57
1111	14-1997	Bull Creek near Colton, Oreg.............	4.16	1953, 1957–64.	1961	16.28	289	Dec. 22	15.64	246	[2] 1.42

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		Willamette River basin—Continued									
		Willamette River basin—Continued									
1112	14-2000	Molalla River near Canby, Oreg.	323	1928–59, 1963–64,	1948	[1] 14.9	25,100	Dec. 22	16.76	43,600	[2] 1.37
1113	14-2003	Silver Creek at Silverton, Oreg.	47.9	1963–64	1964	8.03	2,850	Dec. 22	11.15	5,900	[2] 1.04
1114	14-2010	Pudding River near Mount Angel, Oreg.	204	1939–64	1949	[21] 30.38	15,000	Dec. 22	[21] 31.63	16,700	[2] 1.02
1115	14-2020	Pudding River at Aurora, Oreg.	479	1928–64	1937	29.5	25,400	Dec. 23	29.57	26,200	[2] 1.15
				1923	1923	30.0	27,900				
1116	14-2030	Scoggins Creek near Gaston, Oreg.	43.3	1940–64	1955	15.94	5,320	Dec. 22	15.70	4,890	[2] 1.07
1117	14-2035	Tualatin River near Dilley, Oreg.	133	1939–64	1955	14.78	13,200	Dec. 22	15.34	17,100	[2] 1.47
1118	14-2038	Beaver Creek near Glenwood, Oreg.	4.70	1952–64	1963	20.04	472	Dec. 21	19.28	331	22
1119	14-2040	Gales Creek near Gales Creek, Oreg.	33.9	1935–45, 1963–64.	1964	8.40	3,700	Dec. 22	8.63	3,970	[2] 1.34
1120	14-2041	Bateman Creek near Glenwood, Oreg.	1.34	1952–64	1955	16.0	145	Dec. 21	12.72	85	6
1121	14-2075	Tualatin River at West Linn, Oreg.	710	1928–64	1933		[6] 29,300	Dec. 26		[6] 17,700	
1122	14-2080	Clackamas River at Big Bottom, Oreg.	136	1920–64	1931, 1946		6,750	Dec. 22	10.55	11,200	[2] 1.23
					1955	[1] 8.96					
1123	14-2087	Oak Grove Fork near Government Camp, Oreg.	54.4	1956–64	1962	2.84	[6] 499	Dec. 24	3.93	[6] 2,110	[2] 2.20
1124	14-2088.5	East Fork Shellrock Creek near Government Camp, Oreg.	2.30					Dec. 22	13.36	103	
1125	14-2090	Oak Grove Fork above powerplant intake, Oreg.	126	1909–64	1923	[1] 5.45	5,000	Dec. 23	5.84	[6] 4,180	20
1126	14-2091	Kink Creek near Government Camp, Oreg.	3.75	1957–64	1958	16.44	60	Dec. 21	[7] 18.78	94	
1127	14-2095	Clackamas River above Three Lynx Creek, Oreg.	479	1909–13, 1921–64.	1931	15.5	34,800	Dec. 22	21.7	68,200	[2] 1.66
1128	14-2097.5	Whiskey Creek near Estacada, Oreg.	1.06					Dec. 22	15.64	249	[2] 1.66
1129	14-2099	DuBois Creek at Estacada, Oreg.	2.52	1957–64	1961	19.14	167	Dec. 22	20.80	508	[2] 2.40
1130	14-2100	Clackamas River at Estacada, Oreg.	671	1908–64	1931	[1] 24.5	60,800	Dec. 22	18.36	[6] 86,900	[2] 1.47
1131	14-2108	Rock Creek near Boring, Oreg.	2.25	1957–64	1962	57.16	280	Dec. 22	56.20	257	[2] 1.61
1132		Rock Creek near Carver, Oreg.	8.27					Dec. 22		1,240	[2] 2.18
1133	14-2110	Clackamas River near Clackamas, Oreg.	936	1911–12, 1962–64.	1962		36,200	Dec. 22	27.0	[6] 120,000	[2] 1.42
					1960	20.85					
1134	14-2115	Johnson Creek at Sycamore, Oreg.	28.2	1940–64	1960	13.78	2,180	Dec. 22	14.68	2,620	[2] 1.28
1135	14-2117	Willamette River at Portland, Oreg.	11,200	1963–64	1964		[6] [8] 182,000	Dec. 25	[4] [21] 32.45	[6] 443,000	
1136	14-2118	Saltzman Creek at Portland, Oreg.	1.46	1952–64	1955	13.33	306	Dec. 22	13.06	242	[2] 2.35

Coastal Oregon

		Necanicum River basin:									
1137	14-2990	South Fork Necanicum River near Seaside, Oreg.	7.99	1953-64	1964	8.86	3,040	Dec. 21	7.58	1,710	[2] 1.08
		Asbury Creek basin:									
1138	14-2995	Asbury Creek near Cannon Beach, Oreg.	1.97	1952-64	1961	9.66	314	Jan. 28	9.22	279	6
		Nehalem River basin:									
1139	14-3002	Oak Ranch Creek near Vernonia, Oreg.	11.6	1959-64	1963	17.78	493	Dec. 21	18.46	514	12
1140	14-3010	Nehalem River near Foss, Oreg.	667	1939-64	1964	21.10	43,200	Dec. 23	21.53	40,400	
		Patterson Creek basin:									
1141	14-3014	Patterson Creek at Bay City, Oreg.	1.87	1952-64	1955	13.08	207	Jan. 28	14.38	300	11
		Wilson River basin:									
1142	14-3015	Wilson River near Tillamook, Oreg	161	1914-16, 1931-64.	1933	[1] 19.28	30,000	Dec. 22	20.26	32,100	20
					1916	[1] 20.8					
		Trask River basin:									
1143	14-3025	Trask River near Tillamook, Oreg	145	1931-55, 1961-64.	1933	13.00	20,000	Dec. 22	13.34	23,000	14
				1921	1921	17	30,000				
		Nestucca River basin:									
1144	14-3029	Nestucca River near Fairdale, Oreg.	6.18	1960-64	1962	8.38	612	Dec. 22	10.43	876	[2] 1.40
1145	14-3036	Nestucca River near Beaver, Oreg.	180	1964				Jan. 28	19.53	24,000	[2] 1.15
		Little Nestucca River Basin:									
1146	14-3036.5	Squaw Creek near Neskowin, Oreg.	2.11					Jan. 28	16.11	305	9
		Salmon River basin:									
1147	14-3037	Alder Brook near Rose Lodge, Oreg	1.09	1954-64	1962	12.99	147	Jan. 28	13.97	194	8
1148		Slick Rock Creek near Rose Lodge, Oreg.	8.33				See sediment summary, table 20.				
		Drift Creek basin:									
1149		Drift Creek near Taft, Oreg.	38.0				See sediment summary, table 20.				
		Siletz River basin:									
1150	14-3055	Siletz River at Siletz, Oreg.	202	1905-12, 1924-64.	1949	25.17	37,000	Jan. 28	27.32	32,200	8
				1921	1921	[1] 31.6	40,800				
		Yaquina River basin:									
1151	14-3060.36	Mill Creek near Toledo, Oreg.	4.08	1959-64	1962	4.59	496	Jan. 27	5.83	609	18
		Big Creek basin:									
1152		Big Creek near Newport, Oreg	2.66				See sediment summary, table 20.				
		Alsea River basin:									
1153	14-3061	North Fork Alsea River at Alsea, Oreg	63.0	1957-64	1960	11.80	8,820	Dec. 22	14.57	14,100	[2] 1.51
				1955	1955	13.30	12,000				

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known				Maximum December 1964 and January 1965			
				Period of record	Year	Gage height (ft)	Discharge (cfs)	Day	Gage height (ft)	Discharge: Cfs	Discharge: Recurrence interval (yr)
		Coastal Oregon—Continued									
		Alsea River basin—Continued									
1154	14-3065	Alsea River near Tidewater, Oreg.	334	1939–64	1960	24.02	32,800	Dec. 22	27.44	41,800	28
				1890	1890	29.5					
1155	14-3066	Drift Creek near Salado, Oreg.	20.6	1958–63	1962	8.34	2,500	Dec. or Jan.	9.86	4,050	41
1156	14-3067	Needle Branch near Salado, Oreg.	.27	1958–64	1960		33	Jan. 28	3.31	50	
					1961	[7] 3.10					
1157	14-3068	Flynn Creek near Salado, Oreg	.78	1958–64	1960	4.35	78	Jan. 28	4.72	137	12
1158	14-3068.1	Deer Creek near Salado, Oreg.	1.17	1958–64	1960	3.69	114	Jan. 28	4.21	201	15
1159	14-3068.3	Lyndon Creek near Waldport, Oreg.	.90					Jan. 28	9.04	142	11
1160	14-3068.5	South Fork Weiss Creek near Waldport, Oreg.	.33	1953–64	1953	6.92	30	Jan. 28	7.54	54	
		Yachats River basin:									
1161		Yachats River near Yachats, Oreg.	39.0	See sediment summary, table 20.							
		Siuslaw River basin:									
1162	14-3075.5	Deadwood Creek tributary at Alpha, Oreg.	.75	1957–64	1960	18.51	86	Dec. 22	18.68	89	4
1163	14-3076.1	Siuslaw River tributary near Rainrock, Oreg.	.42	1957–64	1961	7.31	39	Jan. 24	7.56	52	
1164	14-3076.4	Sam Creek near Minerva, Oreg.	2.58					Jan. 24	12.62	450	18
		Umpqua River basin:									
1165	14-3076.85	Mult Creek near Tiller, Oreg.	2.65					Dec. 22	16.76	515	[2] 1.30
1166	14-3077	Jackson Creek near Tiller, Oreg.	152	1955–64	1955	13.55	12,700	Dec. 22	18.0	21,100	[2] 1.27
1167	14-3080	South Umpqua River at Tiller, Oreg.	449	1910–11, 1939–64.	1956	22.7	46,400	Dec. 22	25.72	60,200	[2] 1.52
1168	14-3085	Elk Creek near Drew, Oreg.	54.4	1954–64	1955	10.34	7,500	Dec. 22	10.61	8,880	[2] 1.98
				1953	1953	11.8	11,000				
1169	14-3037	Days Creek at Days Creek, Oreg.	55.3	1955–64	1956	[1] 11.24	3,450	Dec. 22	11.5	2,390	3
1170	14-3089.5	Beaver Creek near Drew, Oreg.	1.61					Dec. 22	10.60	138	5
1171	14-3090	Cow Creek near Azalea, Oreg.	78.0	1926–64	1950	14.37	5,920	Dec. 22	15.63	8,430	[2] 1.14
1172	14-3095	West Fork Cow Creek near Glendale, Oreg.	86.9	1955–64	1955	[1] 18.60	10,600	Dec. 22	18.59	15,700	18
1173	14-3100	Cow Creek near Riddle, Oreg.	456	1954–64	1955	27.35	36,900	Dec. 22	27.67	37,500	12
				1950	1950	28.5	41,100				

1174	14-3107	South Myrtle Creek near Myrtle Creek, Oreg.	43.9	1955-64	1956	7.72	3,050	Dec. 22	7.34	2,900	9
1175	14-3109	West Fork Frozen Creek near Myrtle Creek, Oreg.	3.16	1955-64	1955	19.64	300	Dec. 22	18.68	224	18
1176	14-3110	North Myrtle Creek near Myrtle Creek, Oreg.	54.2	1955-64	1964		3,260	Dec. 22	10.67	2,840	4
					1955	[7] 11.58					
1177	14-3112	Olalla Creek near Tenmile, Oreg.	60.5	1956-64	1959	11.15	7,670	Dec. 22	10.14	6,110	[2] 1.16
				1955	1955	13.6	12,300				
1178	14-3115	Lookingglass Creek at Brockway, Oreg.	158	1955-64	1955	24.93	35,000	Dec. 22		18,000	[2] 1.14
								Dec. 23	[7] 25.28		
1179	14-3120	South Umpqua River near Brockway, Oreg.	1,670	1905-12, 1923-26, 1942-64.	1950	32.4	102,000	Dec. 23	34.28	105,000	50
				1890	1890	33.1	130,000				
1180	14-3121	Parrott Creek at Roseburg, Oreg.	2.42	1952-64	1955	15.24	290	Dec. 22	14.20	231	[2] 1.10
1181	14-3122	Deer Creek near Roseburg, Oreg.	54.3	1955-64	1955	13.67	6,800	Dec. 22	11.88	4,890	[2] 1.03
				1950	1950	13.38	6,460				
1182	14-3123	Marks Creek near Roseburg, Oreg.	1.26	1952-64	1961	16.10	260	Dec. 22	14.06	178	[2] 1.62
1183	14-3135	North Umpqua River below Lemolo Lake, near Toketee Falls, Oreg.	170	1927-64	1956		[6] 1,400	Dec. 25	[22] 9.20	[6] 4,680	[2] 2.87
1184	14-3145	Clearwater River above Trap Creek, near Toketee Falls, Oreg.	41.6	1927-64	1955		[6] 598	Dec. 23	[22] 7.19	[6] 1,020	
1185	14-3160	Fish Creek at Big Camas ranger station, near Toketee Falls, Oreg.	68.8	1947-64	1955		[24] 9,880	Dec. 22	[22] 13.9	[6] 12,100	[2] 2.55
1186	14-3165	North Umpqua River above Copeland Creek, near Toketee Falls, Oreg.	475	1949-64	1955	14.84	[6] 25,000	Dec. 22	19.1	[6] 40,700	[2] 3.87
1187	14-3166	Dog Creek near Idleyld Park, Oreg.	3.93					Dec. 22	17.38	810	[2] 1.06
1188	14-3166.5	Fugawee Creek near Disston, Oreg.	2.01					Dec. 22	15.77	361	40
1189	14-3167	Steamboat Creek near Glide, Oreg.	227	1955-64	1955	17.96	26,900	Dec. 22	25.6	51,000	[2] 1.29
1190	14-3176	Rock Creek near Flide, Oreg.	97.4	1955-64	1956	15.46	13,400	Dec. 22	20.3	22,800	[2] 1.24
1191	14-3177	White Creek near Peel, Oreg.	3.92					Dec. 22	16.92	950	[2] 1.13
1192	14-3178	Cavitt Creek near Peel, Oreg.	56.9	1956-64	1956	9.54	10,600	Dec. 22	10.81	5,870	6
1193	14-3180	Little River at Peel, Oreg.	177	1954-64	1956	19.63	21,100	Dec. 22	19.55	20,900	22
				1953	1953	20.6	22,700				
1194	14-3186	North Umpqua River tributary near Glide, Oreg.	.75	1956-64	1955	14.26	188	Dec. 21	11.54	73	13
1195	14-3192	Sutherlin Creek at Sutherlin, Oreg.	16.4	1955-64	1961		2,250	Dec. 22	6.96	1,450	[2] 1.57
					1957	[1] 8.24					
1196	14-3195	North Umpqua River at Winchester, Oreg.	1,344	1908-13, 1923-29, 1954-64.	1909	[1] 28.1	100,000	Dec. 22	34.2	[6] 119,000	[2] 1.46
					1953	28.4	93,300				
1197	14-3206	Cabin Creek tributary near Oakland, Oreg.	1.28	1957-64	1961	13.26	246	Dec. 21	12.59	208	[2] 1.98
1198	14-3207	Calapooya Creek near Oakland, Oreg.	210	1955-64	1961	21.55	26,600	Dec. 22	20.72	21,000	17
1199	14-3210	Umpqua River near Elkton, Oreg.	3,683	1905-64	1955	46.0	218,000	Dec. 23	51.95	265,000	[2] 1.18
1200	14-3219	Yoncalla Creek near Yoncalla, Oreg.	26.0	1956-64	1964	15.43	1,590	Dec. 22	14.74	1,470	14
1201	14-3220	Elk Creek near Drain, Oreg.	104	1955-64	1961	23.7	15,000	Dec. 22	19.48	10,300	18
1202	14-3224	Pass Creek near Drain, Oreg.	61.9	1956-64	1961	16.7	10,300	Dec. 22	15.20	8,450	[2] 1.78
1203	14-3227	Bear Creek near Drain, Oreg.	5.13	1952-64	1961	15.89	674	Dec. 22	14.99	389	7

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		Coastal Oregon—Continued									
		Tenmile Creek basin:									
1204	14-3232	Tenmile Creek near Lakeside, Oreg.	87	1957-64	1959	[4] 15.56	2,750	Dec. 26	[4] 16.46	3,330	17
1205	14-3233	Eel Creek at Lakeside, Oreg.	11	1958-64	1959	3.52	223	Jan. 29	3.56	250	6
		Coos River basin:									
1206	14-3245	West Fork Millicoma River near Allegany, Oreg.	46.5	1954-64	1960	15.86	8,100	Dec. 22	13.02	5,560	10
				1953	1953	17.9					
		Coquille River basin:									
1207	14-3246	South Fork Coquille River above Panther Creek, near Illahe, Oreg.	31.2	1956-64	1964	12.79	4,220	Dec. 22	17.07	8,840	[2] 1.20
				1955	1955	15.7	6,300				
1208	14-3247	South Fork Coquille River near Illahe, Oreg.	40.6	1956-64	1964	10.12	6,770	Dec. 22	11.80	12,000	[2] 1.23
				1955	1955	10.8	8,600				
1209	14-3249	South Fork Coquille River near Powers, Oreg.	93.2	1956-64	1964	15.93	14,900	Dec. 22	23.00	29,600	[2] 1.18
1210	14-3250	South Fork Coquille River at Powers, Oreg.	169	1916-26, 1928-64.	1945	20.57	30,500	Dec. 22	26.51	48,900	[2] 1.24
1211	14-3266	Gettys Creek near Myrtle Point, Oreg.	1.45	1953-64	1961	18.29	245	Dec. 22	13.04	145	12
1212	14-3268	North Fork Coquille River near Fairview, Oreg.	74.0	1963-64	1964	17.18	4,440	Jan. 28	17.06	4,660	4
1213	14-3270	North Fork Coquille River near Myrtle Point, Oreg.	282	1929-46, 1963-64.	1964	37.45	37,100	Dec. 23	37.67	38,400	[2] 1.04
				1909 or 1910.	1909 or 1910	41.2					
		Geiger Creek basin:									
1214	14-3271	Geiger Creek near Bandon, Oreg.	1.36	1953-64	1961	30.74	206	Dec. 22	19.03	47	<2
		Brush Creek basin:									
1215	14-3274	Dry Run Creek near Port Orford, Oreg.	.86	1954-64	1958	18.14	158	Jan. 23	14.61	74	<2
		Rogue River basin:									
1216	14-3274.9	National Creek near Union Creek, Oreg.	19.3					Dec. 22	22.83	475	<2
1217	14-3280	Rogue River above Prospect, Oreg.	312	1908-12, 1923-64.	1955	10.01	16,600	Dec. 22	11.55	22,400	38
1218	14-3320	South Fork Rogue River near Prospect, Oreg.	83.8	1924-64	1955	8.3	3,180	Dec. 22	11.1	7,010	[2] 2.26
1219	14-3334.9	Elkhorn Creek near Prospect, Oreg.	1.50					Dec. 22	11.60	111	26
1220	14-3335	Red Blanket Creek near Prospect, Oreg.	45.5	1925-64	1955	7.30	1,840	Dec. 22	7.85	3,190	27
1221	14-3350	Rogue River below South Fork Rogue River, near Prospect, Oreg.	650	1928-64	1955	[1] 17.3	34,000	Dec. 22	23.0	55,000	[2] 1.50

1222	14-3355	South Fork Big Butte Creek near Butte Falls, Oreg.	138	1910–11, 1915, 1917–22, 1925–64.	1955	4.50	[6] 2,770	Dec. 22	7.65	[6] 12,600	[2] 3.90
1223	14-3380	Elk Creek near Trail, Oreg.	133	1945–64	1955	14.34	13,700	Dec. 22	18.84	19,200	43
1224	14-3390	Rogue River at Dodge Bridge, near Eagle Point, Oreg.	1,215	1938–64	1955	12.90	75,000	Dec. 22	12.78	87,600	[2] 1.24
1225	14-3392	Constance Creek near Sams Valley, Oreg.	6.42	1959–64	1962	18.60	950	Dec. 22	17.70	744	[2] 2.58
1226	14-3415	South Fork Little Butte Creek near Lakecreek, Oreg.	138	1921–64	1962	8.35	7,660	Dec. 22	7.55	6,280	[2] 2.02
1227	14-3425	North Fork Little Butte Creek at Fish Lake, near Lakecreek, Oreg.	20.8	1914–64	1917		[24] 940	Dec. 28		[6,8] 114	
1228	14-3430	North Fork Little Butte Creek near Lakecreek, Oreg.	44.4	1911–13, 1917, 1922–64.	1956	3.56	[6] 1,430	Dec. 22	3.70	[6] 1,750	[2] 1.41
1229	14-3500	Emigrant Creek near Ashland, Oreg.	64.3	1920–64	1927		[6] 5,260	Dec. 24	6.00	[6] 730	
1230	14-3509	Neil Creek above Dunn ditch near Ashland, Oreg.	10.3	1962–63	1962	10.65	224	Dec. 22	16.30	766	[2] 2.89
1231	14-3544	Butler Creek near Ashland, Oreg.	5.11	1962–64	1962	29.17	322	Dec. 21	32.11	387	13
1232	14-3575	Bear Creek at Medford, Oreg.	289	1915–64	1962	8.04	[6] 14,500	Dec. 22	8.65	[6] 12,300	19
					1927	[1] 11.0					
1233	14-3590	Rogue River at Raygold, near Central Point, Oreg.	2,053	1905–64	1955	21.55	[6] 110,000	Dec. 23	23.43	[6] 131,000	[2] 1.49
					1927	[1] 24.8	[6] 110,000				
				1861	1861	32					
1234	14-3613	Jones Creek near Grants Pass, Oreg.	7.41	1951–64	1956	[1] 16.50	1,350	Dec. 21	14.63	489	8
1235	14-3615	Rogue River at Grants Pass, Oreg	2,459	1938–64	1955	32.6	135,000	Dec. 23	34.15	152,000	[2] 1.23
				1861	1861	42					
1236	14-3620	Applegate River near Copper, Oreg.	223	1938–64	1955	23.47	20,300	Dec. 22	26.00	29,000	21
1237	14-3620.5	Kinney Creek near McKee Bridge, Oreg.	2.83					Dec. 22	12.33	177	8
1238	14-3660	Applegate River near Applegate, Oreg.	483	1938–64	1955	18.00	35,700	Dec. 22	19.57	45,700	[2] 1.42
				1927	1927	18.7					
1239	14-3698	Butcherknife Creek near Wonder, Oreg.	3.07	1953–64	1955, 1959	16.84	310	Dec. 22	17.24	390	10
1240	14-3700	Slate Creek at Wonder, Oreg.	31.4	1944–60	1950	9.72	4,020	Dec. 22	10.64	4,650	12
1241	14-3702	Round Prairie Creek near Wilderville, Oreg.	3.16	1953–64	1954	6.73	305	Dec. 21	6.43	278	5
1242	14-3715	Grave Creek at Pease Bridge, near Placer, Oreg.	22.1	1940–64	1955	9.66	4,610	Dec. 22	11.20	6,240	38
1243	14-3723	Rogue River near Agness, Oreg.	3,939	1960–64	1962	27.92	138,000	Dec. 23	[7] 68.03	290,000	[2] .98
1244	14-3725	East Fork Illinois River near Takilma, Oreg.	43.4	1926–32, 1940–64.	1955	10.05	8,230	Dec. 22	13.0	15,700	[2] 2.06
1245	14-3750	Sucker Creek near Holland, Oreg.	76.2	1940–64	1959	3.00	7,300	Dec. 22	9.28	17,500	[2] 2.77
1246	14-3755	West Fork Illinois River below Rock Creek, near O'Brien, Oreg.	42.4	1954–64	1955	14.79	12,100	Dec. 22	16.05	16,100	[2] 1.14
1247	14-3771	Illinois River near Kerby, Oreg.	381	1961–64	1962	30.51	41,100	Dec. 22	45.28	92,200	[2] 1.67
				1955	1955		[1] 56,800				
1248	14-3778	Snailback Creek near Selma, Oreg.	1.62	1956–64	1955	95.50	278	Dec. 21	97.43	329	8

See footnotes at end of table.

TABLE 19.—*Summary of flood stages and discharges*—Continued

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of record	Year	Gage height (ft)	Discharge (cfs)	Maximum December 1964 and January 1965: Day	Gage height (ft)	Discharge: Cfs	Recurrence interval (yr)
		Coastal Oregon—Continued									
		Rogue River basin—Continued									
1249	14-3779	Secret Creek near Wonder, Oreg	6.11					Dec. 22	18.92	1,080	6
1250	14-3780	Illinois River near Selma, Oreg	665	1956-64	1958	22.3	70,100	Dec. 22	34.0	160,000	[2] 1.69
				1955	1955	25.64	97,000				
1251	14-3782	Illinois River near Agness, Oreg	988	1960-64	1964	20.43	73,900	Dec. 22	[7] [21] 56.91	225,000	[2] 1.22
		Hunter Creek basin:									
1252	14-3785.5	Hunter Creek near Gold Beach, Oreg	.98					Jan. 30	16.30	870	[2] 1.74
		Harris Creek basin:									
1253	14-3788	Harris Creek near Brookings, Oreg	1.05	1953-64	1954	25.98	439	Jan. 23	15.06	89	<2
		Ransom Creek basin:									
1254	14-3789	Ransom Creek near Brookings, Oreg	.74	1953-64	1953		300	Dec. 22	23.93	54	<2
					1956	[7] 26.52					

[1] Site and (or) datum then in use.
[2] Ratio of peak discharge to 50-year flood.
[3] Unknown, or not determined.
[4] Elevation, in feet.
[5] Usable contents, in acre-feet.
[6] Affected by storage and (or) diversions; see station description.
[7] Affected by backwater; see station description.
[8] Maximum daily discharge, in cubic feet per second.
[9] From inside gage; floodmark elevation in station description.
[10] Net contributing area, see station description.
[11] Total contents, in acre-feet.
[12] Includes bypass flow; see station description.
[13] Two-hour average maximum inflow, in cubic feet per second.
[14] Maximum inflow, in cubic feet per second.
[15] Maximum outflow, in cubic feet per second.
[16] Recurrence interval from station frequency curve.
[17] Contents observed several days in June and July each year 1948–54, 1956–58, 1960, 1962–63.
[18] Natural flow estimated as 170 cfs; augmented by water escaping through break in reservoir outlet conduit.
[19] Hydrologic drainage boundary uncertain; see station description.
[20] Ratio of peak discharge to 50-year flood from station frequency curve.
[21] Occurred at different time than maximum discharge; see station description.
[22] River only.
[23] Maximum hourly inflow, in cubic feet per second.
[24] Result of failure of dam or dam appurtenances; see station description.
[25] Daily mean gage height, in feet.

SUMMARY OF MAXIMUM SUSPENDED-SEDIMENT CONCENTRATIONS AND LOADS

Maximum suspended-sediment concentrations and daily sediment loads at 109 daily and periodic sediment stations are summarized in table 20. The reference numbers in this table correspond to the numbers used on the location maps and for identification in Water-Supply Paper 1866-B. The permanent network-station numbers are shown also for added identification, as in the table summarizing flood stages and discharges (table 19).

The derivation of the maximum data is explained in the station description for each site given in part 2 of this report (WSP 1866-B). The figures of sediment load during the indicated flood periods were derived by summation of daily sediment loads for the period of time that the daily loads were more than 5 percent of that for the maximum day. Except where specifically noted, all load values are for suspended sediment.

Sediment stations within the area covered by this report have been operated for a relatively short time. The information on suspended-sediment concentrations and loads for previous floods (table 20) may not be fully representative of the conditions to be expected during extreme floods. Data are not available, for example, to indicate the loads transported by the floods of December 1955.

TABLE 20.—*Summary of maximum suspended*

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Period of record	Maximum sediment concentration			
					Previous		1964–65	
					Date	Ppm	Date	Ppm
								San Joaquin River and
		San Joaquin River basin:						
164	11-3035	San Joaquin River near Vernalis, Calif.	13,540	1956–64	1963	[1] 951	Dec. 25	2,490
197	11-3350	Cosumnes River at Michigan Bar, Calif.	536	1962–64	1963	[1] 3,070	Jan. 6	3,400
200	11-3360	Cosumnes River at McConnell, Calif.	724				Dec. 23	[2] 1,080
		Sacramento River basin:						
238	11-3710	Clear Creek at French Gulch, Calif.	115	1964			Dec. 22	2,750
248	11-3744	Middle Fork Cottonwood Creek near Ono, Calif.	249	1964			Dec. 22	[1] 10,000
254	11-3760	Cottonwood Creek near Cottonwood, Calif.	922	1962–64	1963	[1] 2,840	Dec. 22	9,600
256	11-3765.5	Battle Creek below Coleman Fish Hatchery, near Cottonwood, Calif.	358				Dec. 22	[3] 722
258	11-3780	Sacramento River near Red Bluff, Calif.	9,022	1957–64	1960	[1] 1,510	Dec. 22	4,520
262	11-3795	Elder Creek near Paskenta, Calif.	92.9				Dec. 22	[2] 13,800
266	11-3820	Thomes Creek at Paskenta, Calif.	194	1962–64	1963	[1] 8,530	Dec. 22	76,000
326	11-4070	Feather River at Oroville, Calif.	3,624	1956–64	1963	[1] 4,100	Dec. 25	7,700
327	11-4071.5	Feather River near Gridley, Calif.	3,676	1964			Dec. 25	[1] 1,340
358	11-4230	Bear River near Auburn, Calif.	138				Dec. 22	[2] 308
400	11-4475	Sacramento River at Sacramento, Calif.	23,530	1956–64	1963	[1] 1,180	Dec. 24	2,200
416	11-4525	Cache Creek at Yolo, Calif.	1,138	1958–64	1959	[1] 6,130	Jan. 5	17,000
420	11-4535	Putah Creek near Guenoc, Calif.	112	1964			Jan. 5	3,400
								North-coastal
		Russian River basin:						
443	11-4610	Russian River near Ukiah, Calif.	99.7	1964			Dec. 22	13,800
446	11-4620	East Fork Russian River near Ukiah, Calif.	105	1964			Dec. 25	[1, 5] 1,900
450	11-4630	Russian River near Cloverdale, Calif.	502	1964			Dec. 22	6,900
458	11-4652	Dry Creek near Geyserville, Calif.	162	1964	1964	[1] 1,660	Dec. 22	[1, 5] 15,000
		Eel River basin:						
490	11-4725	Eel River above Dos Rios, Calif.	705	1957–64	1963	[1] 7,090	Dec. 22	[1, 5] 8,000
492	11-4730	Middle Fork Eel River below Black Butte River, near Covelo, Calif.	367	1962–64	1963	[1] 4,500	Dec. 22	[1, 5] 9,000
505	11-4755	South Fork Eel River near Branscomb, Calif.	43.9	1962–64	1963	[1] 1,300	Dec. 22	[1, 5] 4,900
514	11-4770	Eel River at Scotia, Calif.	3,113	1957–64	1960	[1] 7,340	Dec. 23	[1, 5] 32,000
		Mad River basin:						
524	11-4805	Mad River near Forest Glenn, Calif.	143				Dec. 24	[2] 1,450

See footnotes at end of table.

-sediment concentrations and loads

Maximum daily sediment load				Sediment load for flood period			
Previous		1964–65		Previous		1964–65	
Date	Tons	Date	Tons	Period	Tons	Period	Tons
Sacramento River basins							
1958	28,500	Dec. 25	54,100	Apr. 1-10, 1958	163,800	Dec. 23 to Jan. 3	163,300
1963	245,000	Dec. 23	168,000	Jan. 20 to Feb. 5, 1963	277,100	Dec. 20-31	336,900
.....	.....	Dec. 23	[3] 82,800	.....	.....	.....	.....
.....	.....	Dec. 22	25,100	.....	.....	Dec. 21-24	34,800
.....	.....	Dec. 22	297,000	.....	.....	Dec. 21-26	567,200
1963	89,200	Dec. 22	597,000	Jan. 30 to Feb. 3, 1963	208,500	Dec. 21-27	1,113,000
.....	.....	Dec. 22	[3] 18,200	.....	.....	.....	.....
1960	271,000	Dec. 22	876,000	Feb. 19 to Mar. 2, 1958	1,355,000	Dec. 19-27	1,961,000
.....	.....	Dec. 22	[3] 302,000	.....	.....	.....	.....
1963	271,000	Dec. 22	5,070,000	Jan. 30 to Feb. 3, 1963	517,700	Dec. 21-26	9,063,000
1963	1,500,000	Dec. 25	711,000	Jan. 30 to Feb. 2, 1963	2,836,000	Dec. 20-29	2,776,000
.....	.....	Dec. 23	527,000	.....	.....	Dec. 20-29	2,376,000
.....	.....	Dec. 22	[3] 4,370	.....	.....	.....	.....
1963	229,000	Dec. 24	525,000	Jan 30 to Feb. 11, 1963	1,038,000	Dec. 22 to Jan. 3	2,393,000
1963	228,000	Jan. 6	593,000	Jan. 30 to Feb. 2, 1963	440,500	Jan. 3-10	1,300,000
.....	.....	Dec. 22	67,000	.....	.....	Dec. 20-24	120,800
California							
.....	.....	Dec. 22	352,000	.....	.....	Dec. 19-24	630,200
.....	.....	Dec. 25	[5] 22,000	.....	.....	Dec. 24 to Jan. 2	[6] 73,400
.....	.....	Dec. 22	495,000	.....	.....	Dec. 19-29	1,412,000
1964	7,040	Dec. 22	[5] 830,000	.....	.....	Dec. 19-24	[5] 1,538,000
1960	796,000	Dec. 22	[5] 3,500,000	Feb. 7-10, 1960	1,273,000	Dec. 19-26	[6] 7,389,000
1963	567,000	Dec. 22	[5] 2,500,000	Jan. 30 to Feb. 2, 1963	884,000	Dec. 19-28	[5] 6,435,000
1964	14,300	Dec. 22	[5] 230,000	Jan. 30 to Feb. 2, 1963	19,800	Dec. 19-27	[6] 473,600
1960	5,380,000	Dec. 23	[5] 57,000,000	Feb. 7-11, 1960	10,443,000	Dec. 19-27	[6] 140,015,000
.....	.....	Dec. 24	[3] 33,700	.....	.....	.....	.....

TABLE 20.—*Summary of maximum suspended*

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Period of record	Maximum sediment concentration			
					Previous		1964–65	
					Date	Ppm	Date	Ppm
North-coastal								
		Mad River basin—Con.						
528	11-4810	Mad River near Arcata, Calif.	485	1957–64	1964	[1] 5,010	Dec. 22	35,200
		Klamath River basin:						
585	11-5258	Weaver Creek near Douglas City, Calif.	48.4				Dec. 21	[2] 9,020
598	11-5290	South Fork Trinity River near Salyer, Calif.	898	1956–64	1958	[1] 4,190	Dec. 23	[2] 20,400
602	11-5300	Trinity River near Hoopa, Calif.	2,847	1956–64	1959	[1] 3,360	Dec. 22	32,500
Upper Columbia River								
		Columbia River main stem:						
643	12-5140	Columbia River at Pasco, Wash.	104,000	1962–64	1963	[1] 103	Dec. 24	[1] 97
		Payette River basin:						
737	13-2380	Payette River near Banks, Idaho	1,200				Dec. 23	[2] 3,310
740	13-2460	North Fork Payette River near Banks, Idaho.	933				Dec. 23	[2] 106
		Deadman Creek basin:						
818	13-3436.8	Deadman Creek above Meadow Creek, at Central Ferry, Wash.	135	1963-64	1963	[1,5] 110,000	Dec. 23	[6] 360,000
820	13-3438	Meadow Creek near Central Ferry, Wash.	66.2	1963–64	1963	101,000	Dec. 22	[6] 340,000
		Tucannon River basin:						
824	13-3445	Tucannon River near Starbuck, Wash.	431	1962–64	1963	[5] 80,000	Dec. 22	[6] 220,000
		Palouse River basin:						
829	13-3461	Palouse River at Colfax, Wash.	497				Dec. 22	[7] 15,300
830	13-3480	South Fork Palouse River at Pullman, Wash.	132				Dec. 23	[7] 14,600
832	13-3485	Missouri Flat Creek at Pullman, Wash.	27.1				Dec. 23	[7] 28,200
833	13-3492	South Fork Palouse River at Colfax, Wash.	277				Dec. 23	[1,7] 13,000
836	13-3493.1	Palouse River at Winona, Wash.	986				Jan. 28	[8] 8,430
837	13-3493.2	Rebel Flat Creek at Winona, Wash.	75				Jan 28	[8] 73,400
839	13-3494	Pine Creek at Pine City, Wash.	302				Jan. 30	[8] 8,330
840	13-3495	Rock Creek near Ewan, Wash.	523				Feb. 1	[9] 80
841	13-3497	Cottonwood Creek near Ewan, Wash.	110				Jan. 30	[8] 29,700
842	13-3505	Union Flat Creek near Colfax, Wash.	189				Jan 29	[2] 15,900
843	13-3510	Palouse River at Hooper, Wash.	2,500	1961–64	1963	80,000	Dec. 23	28,200
844	13-3525	Cow Creek at Hooper, Wash.	679				Jan 31	[1,8] 500
		Snake River main stem:						
846	13-3530	Snake River below Ice Harbor Dam, Wash.	108,500	1962–64	1963	3,800	Dec. 24	[2] 4,320

See footnotes at end of table.

-sediment concentrations and loads—Continued

Maximum daily sediment load				Sediment load for flood period			
Previous		1964–65		Previous		1964–65	
Date	Tons	Date	Tons	Period	Tons	Period	Tons
California—Continued							
1960	489,000	Dec. 22	3,140,000	Feb. 7–11, 1960	942,700	Dec. 19–28	9,947,000
....	....	Dec. 21	[3] 40,200	....	....	....	....
1958	255,000	Dec. 22	3,020,000	Feb. 18–28, 1958	850,500	Dec. 19–27	8,211,000
1958	967,000	Dec. 23	8,900,000	Feb. 12–28, 1958	4,591,000	Dec. 19–28	27,158,000
and Snake River basins							
1964	[10] 80,500	Dec. 24	[10] 18,900	....	....	....	....
....	....	Dec. 23	[5] 145,000	....	....	....	....
....	....	Dec. 23	[3] 1,600	....	....	....	....
1963	[6] 240,000	Dec. 22	[6] 320,000	Feb. 3, 1963	[6] 240,000	Dec. 22–23	[6] 480,000
1963	108,000	Dec. 22	[6] 290,000	Feb. 3, 1963	108,000	Dec. 22	[6] 290,000
1963	276,000	Dec. 22	1,600,000	Feb. 3–5, 1963	381,000	Dec. 22–24	2,350,000
....	....	Dec. 23	[7] 113,000	....	....	....	....
....	....	Dec. 23	[7] 58,700	....	....	....	....
....	....	Dec. 23	[7] 34,200	....	....	....	....
....	....	Dec. 23	[7] 128,000	....	....	....	....
....	....	Jan. 29	[8] 127,000	....	....	....	....
....	....	Jan. 28	[8] 67,500	....	....	....	....
....	....	Jan. 29	[6] 37,000	....	....	....	....
....	....	....	....	....	....	....	....
....	....	Jan. 28	[8] 28,300	....	....	....	....
....	....	Jan. 29	[3] 113,000	....	....	....	....
1963	2,110,000	Dec. 23	588,000	Feb. 3–6, 1963	1,059,000	Dec. 22–25	973,900
....	....	Jan. 31	[8] 87	....	....	....	....
1963	686,000	Dec. 24	[3] [18] 2,340,000	....	....	....	....

TABLE 20.—*Summary of maximum suspended-*

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Period of record	Maximum sediment concentration			
					Previous		1964–65	
					Date	Ppm	Date	Ppm
								Lower Columbia
		Walla Walla River basin:						
850	14-0120	Walla Walla River at Milton, Oreg.	155				Dec. 23	[2] 7,720
853	14-0136	Mill Creek below Blue Creek, near Walla Walla, Wash.	91	1962–64	1964	[6] 14,000	Dec. 23	[6] 16,000
855	14-0160	Dry Creek near Walla Walla, Wash.	48.4				Dec. 22	[1,7] 53,000
856	14-0160.5	Dry Creek at Lowden, Wash.	246				Dec. 22	[6] 350,000
857	14-0161	Pine Creek near Touchet, Wash.	170				Jan. 27	[8] 35,000
860	14-0166.4	East Fork Touchet River at Dayton, Wash.	108				Dec. 24	[2] 5,700
863	14-0168	Patit Creek near Dayton, Wash.	53.5				Dec. 2	[2] 5,210
864	14-0169	Whiskey Creek near Waitsburg, Wash.	16.4				Dec. 1	[2] 7,210
865	14-0169.5	Coppei Creek at Waitsburg, Wash.	34.1				Jan. 28	[2] 19,700
866	14-0170	Touchet River at Bolles, Wash.	361				Jan. 29	[8] 25,000
870	14-0171.2	Touchet River at Lamar, Wash.	520				Jan. 29	[8] 37,500
873	14-0176	Touchet River at Touchet, Wash.	747	1963–64	1963	[5] 140,000	Jan. 6	84,200
874	14-0185	Walla Walla River near Touchet, Wash.	1,657	1962–64	1963	[6] 120,000	Dec. 22	[6] 120,000
		Umatilla River basin:						
878	14-0200	Umatilla River above Meacham Creek, near Gibbon, Oreg.	125				Jan. 28	[2] 4,200
879	14-0203	Meacham Creek near Gibbon, Oreg.	177				Jan. 28	[2] 2,220
880		Umatilla River at Cayuse, Oreg.	394				Dec. 24	[2] 959
889	14-0335	Umatilla River near Umatilla, Oreg.	2,290	1962–64	1963	13,800	Jan. 6	24,500
		Alder Creek basin:						
896	14-0343.5	Alder Creek at Alderdale, Wash.	197	1962–64	1963	[5] 30,200	Dec. 22	[5] 30,000
		Willow Creek basin:						
898	14-0345	Willow Creek at Heppner, Oreg.	87	1963–64	1963	87,600	Dec. 22	125,000
900	14-0360	Willow Creek near Arlington, Oreg.	850	1962–64	1964	108,000	Dec. 22	[5] 153,000
		China Creek basin:						
901		China Creek near Arlington, Oreg.	48.6				Dec. 23	[9] 4,470
		Rock Creek basin:						
903	14-0366	Rock Creek near Roosevelt, Wash.	213	1962–64	1963	[5] 32,000	Dec. 22	[5] 30,000
		John Day River basin:						
906	14-0385	John Day River at Prairie City, Oreg.	231				Jan 31	[2] 617
910	14-0400	South Fork John Day River at Dayville, Oreg.	600				Jan 30	[2] 3,780
911	14-0405	John Day River at Picture Gorge, near Dayville, Oreg.	1,680				Feb. 1	[2] 3,220
915	14-0425	Camas Creek near Ukiah, Oreg.	121				Jan 31	[9] 164
919	14-0440	Middle Fork John Day River at Ritter, Oreg.	515				Jan 31	[9] 531
920	14-0460	North Fork John Day River at Monument, Oreg.	2,520				Jan 31	[2] 1,660

See footnotes at end of table.

sediment concentrations and loads—Continued

Maximum daily sediment load				Sediment load for flood period			
Previous		1964–65		Previous		1964–65	
Date	Tons	Date	Tons	Period	Tons	Period	Tons
River basin							
....	....	Dec. 23	[3] 49,600	....	....	....	....
1964	13,200	Dec. 23	59,300	Nov. 24–25 1964	16,740	Dec. 22–24	89,200
....	....	Dec. 22	[7] 100,000	....	....	....	....
....	....	Dec. 22	[6] 1,600,000	....	....	....	....
....	....	Jan. 30	[8] 110,000	....	....	....	....
....	....	Jan. 30	[3] 31,900	....	....	....	....
....	....	Dec. 24	[3] 2,840	....	....	....	....
....	....	Dec. 1	[3] 4,280	....	....	....	....
....	....	Jan. 28	[3] 23,800	....	....	....	....
....	....	Jan. 29	[8] 257,000	....	....	....	....
....	....	Jan. 29	[8] 367,000	....	....	....	....
1963	[5] 513,000	Dec. 23	1,200,000	Feb. 3-5, 1963	[6] 745,600	Dec. 22–25	2,290,000
1963	818,000	Dec. 23	3,230,000	Feb. 3–5, 1963	1,190,000	Dec. 22–25	6,000,0000
....	....	Jan. 28	[3] 32,300	....	....	....	....
....	....	Jan. 28	[3] 18,700	....	....	....	....
....	....	Dec. 24	[3] 11,000	....	....	....	....
1963	87,300	Jan. 30	438,000	Feb. 3–7, 1963	203,000	Jan. 28 to Feb. 3	1,130,000
1963	[5] 45,000	Dec. 22	[5] 180,000	Feb. 3, 1963	[5] 45,000	Dec. 22–23	[5] 255,000
1963	4,370	Dec. 22	28,400	Feb. 2–6, 1963	7,700	Dec. 22–25	39,600
1963	91,400	Dec. 22	[5] 980,000	Feb. 2–6, 1963	166,000	Dec. 22–24	[6] 1,120,000
....	....	....	....	....	....	....	....
1963	[5] 44,000	Dec. 22	[5] 200,000	Feb. 3–4, 1963	[5] 46,400	Dec. 22–24	[5] 278,000
....	....	Jan. 31	[3] 1,780	....	....	....	....
....	....	Jan. 30	[3] 39,800	....	....	....	....
....	....	Feb. 1	[3] 37,500	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	Jan. 31	[3] 91,400	....	....	....	....

TABLE 20.—*Summary of maximum suspended*

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Period of record	Maximum sediment concentration			
					Previous		1964–65	
					Date	Ppm	Date	Ppm
								Lower Columbia River
		John Day River basin—Continued						
926	14-0480	John Day River at McDonald Ferry, Oreg.	7,580	1962–64	1963	[6] 19,500	Dec. 22	100,000
		Spanish Hollow basin:						
932		Spanish Hollow at Biggs, Oreg.	52.4				Dec. 23	[2] 64,800
		Columbia River main stem:						
933		Columbia River at Biggs, Oreg.	226,000				Dec. 23	[2] 7,050
		Deschutes River basin:						
973	14-1030	Deschutes River at Moody, near Biggs, Oreg.	10,500				Dec. 23	[2] 9,780
		Columbia River main stem:						
1008	14-1447	Columbia River at Vancouver, Wash.	241,000	1962–64	1963	600	Dec. 25	3,970
								Willamette
		Willamette River basin:						
1019	14-1475	North Fork of Middle Fork Willamette River near Oakridge, Oreg.	246				Dec. 28	[9] 158
1035	14-1575	Coast Fork Willamette River near Goshen, Oreg.	642				Dec. 28	[9] 223
1054	14-1655	McKenzie River near Coburg, Oreg.	1,337				Dec. 28	[9] 217
1068	14-1735	Calapooia River at Albany, Oreg.	372				Dec. 27	[9] 136
1069	14-1740	Willamette River at Albany, Oreg.	4,840				Dec. 27	[9] 249
1079	14-1830	North Santiam River at Mehama, Oreg.	665				Jan. 29	[9] 393
1081	14-1850	South Santiam River below Cascadia, Oreg.	174				Dec. 27	[9] 437
1084	14-1865	Middle Santiam River at mouth, near Foster, Oreg.	287				Dec. 27	[9] 579
1086	14-1875	South Santiam River at Waterloo, Oreg.	640				Jan. 29	[2] 2,000
1089	14-1890	Santiam River at Jefferson, Oreg.	1,790				Dec. 26	[2] 1,040
1097	14-1910	Willamette River at Salem, Oreg.	7,280				Dec. 24	[2] 892
1104	14-1940	South Yamhill River near Whiteson, Oreg.	502				Jan. 29	[9] 204
1109	14-1980	Willamette River at Wilsonville, Oreg.	8,400				Dec. 24	[2] 1,080
1112	14-2000	Molalla River near Canby, Oreg.	323				Dec. 24	[2] 1,930
1114	14-2010	Pudding River near Mount Angel, Oreg.	204				Dec. 26	[9] 117
1115	14-2020	Pudding River at Aurora, Oreg.	479				Dec. 24	[2] 263
1121	14-2075	Tualatin River at West Linn, Oreg.	710				Dec. 26	[2] 265
1133	14-2110	Clackamas River near Clackamas, Oreg.	936				Dec. 24	[2] 1,820
1134	14-2115	Johnson Creek at Sycamore, Oreg.	28.2				Dec. 26	[9] 272
1135	14-2117	Willamette River at Portland, Oreg.	11,200	1963–64	1963	209	Dec. 23	[7] 2,050

See footnotes at end of table.

-sediment concentrations and loads—Continued

Maximum daily sediment load				Sediment load for flood period			
Previous		1964–65		Previous		1964–65	
Date	Tons	Date	Tons	Period	Tons	Period	Tons
basin—Continued							
1963	[6] 310,000	Dec. 22	3,800,000	Feb. 2–7, 1963	[6] 616,000	Dec. 21–26	9,030,000
...	...	Dec. 23	[3] 64,000	...	...	...	...
...	...	Dec. 23	[3] 4,800,000	...	...	...	...
...	...	Dec. 23	[3] 1,820,000	...	...	...	...
1964	[10] 360,000	Dec. 25	[10] 3,510,000	...	...	...	...
River basin							
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	Jan. 29	[3] 223,000	...	...	...	...
...	...	Jan. 29	[3] 255,000	...	...	...	...
...	...	Dec. 24	[3] 730,000	...	...	...	...
...	...	...	...	...	...	...	...
...	...	Dec. 24	[3] 951,000	...	...	...	...
...	...	Dec. 24	[3] 89,100	...	...	...	...
...	...	...	...	...	...	...	...
...	...	Dec. 24	[3] 12,400	...	...	...	...
...	...	Dec. 26	[3] 12,600	...	...	...	...
...	...	Dec. 24	[3] 270,000	...	...	...	...
...	...	...	...	...	...	...	...
1964	[13] 76,900	Dec. 23	[7 10] 1,640,000	...	...	...	...

404-080 O - 71 - 17

TABLE 20.—*Summary of maximum suspended*

Location No.	Permanent station No.	Stream and place of determination	Drainage area (sq mi)	Period of record	Maximum sediment concentration			
					Previous		1964–65	
					Date	Ppm	Date	Ppm
Coastal								
		Salmon River basin:						
1148		Slick Rock Creek near Rose Lodge, Oreg.	8.33				Jan. 27	[2] 138
		Drift Creek basin:						
1149		Drift Creek near Taft, Oreg.	38.0				Jan. 27	[2] 2,430
		Siletz Creek basin:						
1150	14-3055	Siletz River at Siletz, Oreg.	202				Jan. 28	[2] 1,260
		Big Creek basin:						
1152		Big Creek near Newport, Oreg.	2.66				Jan. 28	[2] 752
		Alsea River basin:						
1156	14-3067	Needle Branch near Salado, Oreg.	.27	1958–64	1964	1,020	Jan. 28	497
1157	14-3068	Flynn Creek near Salado, Oreg.	.78	1958–64	1962	775	Jan. 28	1,900
1158	14-3068.1	Deer Creek near Salado, Oreg.	1.17	1958–64	1962	795	Jan. 27	1,740
		Yachats River basin:						
1161		Yachats River near Yachats, Oreg.	39.0				Jan. 28	[2] 1,450

[1] Daily.
[2] Periodic observation before or after peak; see station description.
[3] Observed instantaneous load, in tons per day.
[4] Estimated.
[5] From estimated concentration graph.
[6] From partly estimated concentration graph.
[7] December maximum only.
[8] January maximum only.
[9] Periodic observation at time too remote from peak to be representative of maximum concentration; see station description.

[10] Total sediment load; adjusted to include load increment not normally determined by sampling.

-sediment concentrations and loads—Continued

Maximum daily sediment load				Sediment load for flood period			
Previous		1964–65		Previous		1964–65	
Date	Tons	Date	Tons	Period	Tons	Period	Tons
Oregon							
....	....	Jan. 27	[3] 296	....	....	....	....
....	....	Jan. 27	[3] 29,700	....	....	....	....
....	....	Jan. 28	[3] 102,000	....	....	....	....
....	....	Jan. 28	[3] 412	....	....	....	....
1960	15	Jan. 28	33	Nov. 23–25, 1960	20	Jan. 27–29	65
1960	58	Jan. 28	491	Nov. 23–26, 1960	87	Jan. 27–29	687
1960	87	Jan. 28	583	Nov. 23–25, 1960	122	Jan. 27–29	890
....	....	Jan. 28	[3] 21,200	....	....	....	....

STATION DATA

The station data on stage and discharge obtained at 1,254 stations and sites in the area affected by the floods of December 1964 and January 1965, including sediment data at 109 stations, are assembled in Water-Supply Paper 1866–B. The data consist of records of stage and discharge for gaging stations, sediment concentration and load for sediment stations, maximum-stage and discharge information for numerous partial-record stations and miscellaneous sites, and sediment concentration and load for some miscellaneous or periodic sites. All sites are in the area of intensive flooding. The records are presented in more detail than those in the annual reports so that they will be more useful for the many hydraulic and hydrologic studies relative to flood phenomena.

The station data are presented in the same order as the listing of the stations in table 19, summarizing the maximum stages and discharges, and the reference numbers correspond to those on the location maps.

The basic data collected at stream-gaging stations consist of records of stage, measurements of discharge, and general information useful in determining the flow. The records of stage are obtained from the continuous trace of a water-stage recorder or from a digital-recorder tape punched at 15- or 30-minute intervals, from periodic direct readings on a nonrecording gage, or from a remote telephonic interrogation gage (telemark). Discharge measurements are generally made by use of a current meter; however, indirect methods are occasionally used.

The basic data collected at daily sediment stations consist of samples obtained one or more times daily to determine the suspended-sediment concentration of the stream. The concentrations at time of sampling are used to define the concentration graph. Suspended-sediment loads are computed by using data obtained from the concentration graph and the streamflow record.

In general, the information presented for each gaging station includes a description of the station; a tabulation of daily mean discharge for December 1964 and January 1965, or December 1964 through February 1965, as appropriate; and a tabulation of stages and discharges at selected times during each day of the flood rise and recession for the two or three highest flood peaks during the flood period. If available, additional information on daily suspended-sediment concentration and load and on concentration and load at selected intervals during each day of the flood rise and recession is included for the same flood peaks. The station description is presented for partial-record gaging stations, periodic sediment stations, and miscellaneous discharge- and sediment-measurement sites. Available sediment particle-size analyses are also shown.

The station description gives information relative to the location of the gage, size of the drainage area upstream from the gage, nature of the gage-height record obtained during the period covered by this report, datum of gage, definition of the stage-discharge relation, maximum stage and discharge during the December 1964 and January 1965 floods, previous maximum during the period of record, available maximum data for floods outside the period of record, the effect of regulation and diversion, and other pertinent general information. If sediment data are available, information is given for the suspended-sediment sampling frequency, the definition of the suspended-concentration graph, and the maximum daily sediment concentrations and loads for the December 1964 and January 1965 floods and for prior floods within the period of record.

In the tables of daily mean dischargss and daily mean suspended-sediment concentrations and loads, the period shown for each site generally is adequate to show antecedent conditions, floodflows, and enough of the recession from the flood peaks for adequate study of the flood hydrology. Data on the monthly mean discharge, in cubic feet per second; the volume of monthly runoff, in acre-feet and inches; the monthly mean sediment load, in tons per day; and the monthly sediment load, in tons, if available, are included. The discharge-weighted mean concentrations for the month are given also for many daily sediment stations. The monthly runoff, in inches, is not given for stations where regulation or diversion affects the runoff significantly or where the size of the drainage area has not been determined.

Data on stage and discharge at selected times, if such detailed information is warranted, are given in tables that follow the daily mean discharge tables. Suspended-sediment concentration and load are detailed in a similar manner and are included in these tables. Enough detail is presented so that hydrographs and graphs of suspended-sediment concentration and load may be constructed accurately. The flood peaks did not occur on the same days throughout the entire area; thus, the periods of detailed record do not coincide for all streams. Particle-size analyses of suspended sediment, available for some sites, are given in a separate table.

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INDEX

[Italic page numbers indicate major references]

D

G

H

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